

REVISION OF THE GHOST MOTHS¹ (LEPIDOPTERA HOMONEURA, FAMILY HEPIALIDAE)

PART IV.

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Plates v-vii, and Text-fig. 1-51.

IN the course of the revision of the Australian Hepialidae it has become desirable to pay attention to genera and species from several other natural regions. The scope of the study is therefore widened. The presence in southern South America of genera and even species closely related to Australian ones, and the existence of other somewhat more distantly related ones, in the Gondwanan and Himalayan areas of India, has raised generic problems, while the archaic nature of these strange moths necessitates wide study of their relationships. In the present contribution attention is given amongst others to several Asiatic genera, and a new sub-family division is proposed.

Since the preparation of earlier parts one new member of the Australian genus *Trictena* and another of *Bordua* have come under notice, and these are described.

For some years it has been difficult to identify species of Hepialidae from countries outside Europe and the United States. One problem has been scarcity of material, even of species which are of considerable economic importance to forester and farmer. It is also unfortunate that types of the species are widely scattered in collections, and, in a group such as Hepialidae where the older determinations, unchecked by studies of the genitalia and venation, are subject to many doubts, research workers have been chary of describing their material.

Opportunities afforded in 1936-7 by the Carnegie Corporation of New York and by the Australian National Research Council, enabled the writer to spend brief periods in examining types of species preserved in the Berlin Museum; the Senckenberg Museum (Frankfurt-am-Main); the United States National Museum (Washington); American Museum of Natural History (New York); Tring Museum; British Museum (South Kensington), as well as in some smaller collections in the United States of America, Canada, Holland, and Belgium.

I am indebted to Mr. W. H. T. Tams for his assistance in the study of type material in the British Museum, and to Professor A. Seitz, Drs. G. D. H. Carpenter, W. Forbes, M. Hering, K. Jordan, J. McDunnough, W. Schaus, E. P. Van Duzee, and Messrs. T. Bainbridge Fletcher, T. R. Bell, J. C. M. Gardner, and F. C. Watson, who have been kind enough to provide material of this group for study. Types of several new species described in this revision are to be lodged in the British Museum; others are in the South Australian Museum, where, so far as is possible, a paratype series is also preserved. Through the courtesy of collectors and others it has been possible to bring together at Adelaide one of the most extensive extant series of Hepialidae.

The importance of the study of the genitalia, in both sexes, must be stressed; lack of attention to details of these organs has been one of the primary causes of the difficulty experienced in the recognition and classification of the insects. The complex genital armature of the female has been mistaken for that of the male, and in consequence the types of some species have masqueraded under wrong sex designations.

(1) Part 3, entitled Revision of the Australian Ghost Moths, was published in *Rec. S. Aust. Mus.*, v, 1935, pp. 275-322.

The homologies of the female genitalia in the Hepialidae have not hitherto been worked out. For the study of *Endoclyta* and allied genera it is desirable to attempt to identify or define some of the principal parts.

It would appear that, for example, in *E. undulifer*, the seventh sternite is specialized to form a hood over the genitalia (fig. 1-2). Its posterior margin is strongly notched, evidently to enable the eighth sternite to be folded forward when extruded in the act of copulation. The eighth sternite or subgenital plate is itself drawn out posteriorly, and the lateral margins are folded over to form a hollow trough; this may serve as a guide to the intromittent organ of the male.

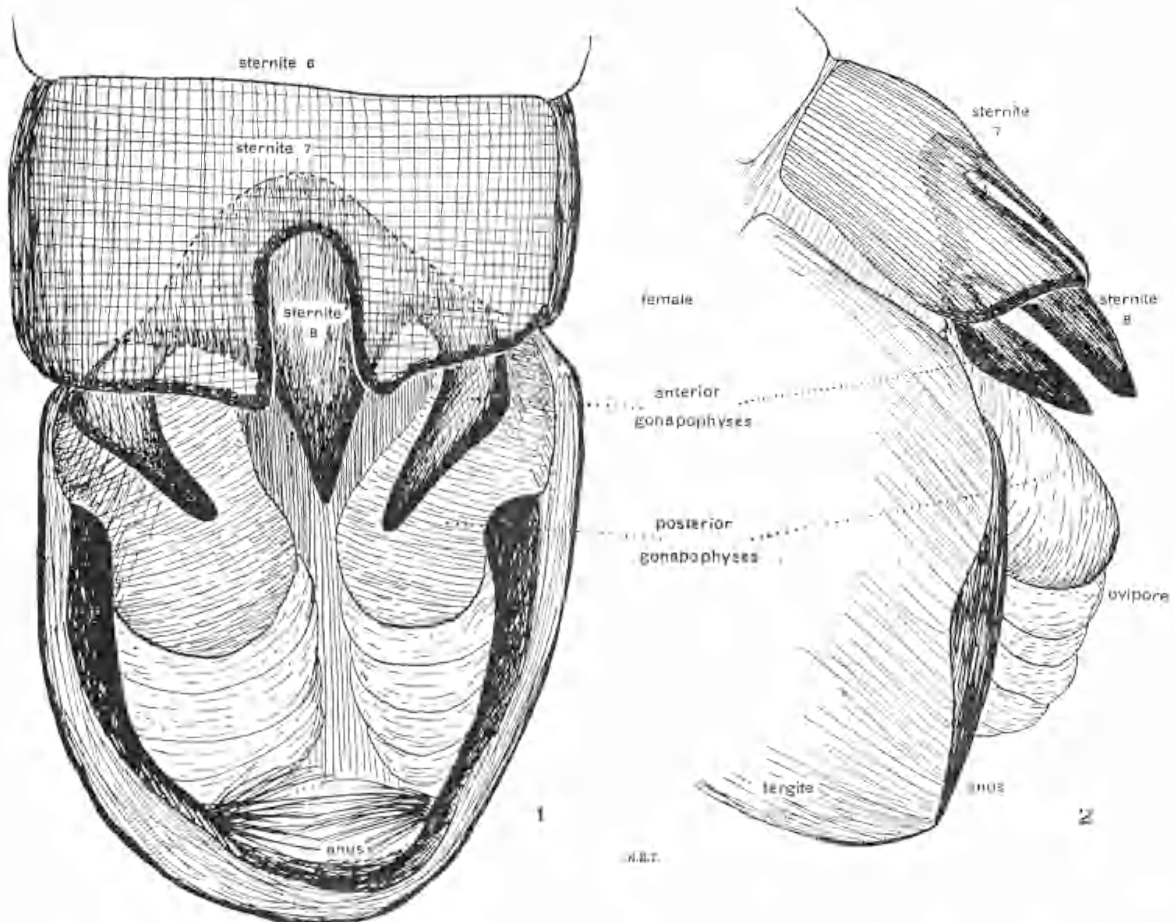


Fig. 1-2. *Endoclyta undulifer* (Walker). 1. Ventral view of female genitalia. 2. Lateral view, composite sketch.

The copulatory opening is concealed beneath the eighth sternite on the margin between the eighth and ninth. Attached to the lateral margins of the eighth sternite are hollow, cylindrical pointed processes, one on each side, which may be homologous with the anterior gonapophyses of more primitive insects. Posterior to these are large swollen, strongly chitinized convex plates (perhaps homologous with the posterior gonapophyses) one on each side of an elongate cloaca-like median cavity leading to the oviporus. Posteriorly from these chitinized plates are curious concertina-like folded protuberances, which may represent rudiments of the lateral gonapophyses. The posterior and lateral gonapophyses can be considered to form an apparatus for carrying the newly extruded egg towards the posterior extremity of the body. There is an anal opening situated at the extremity of the abdomen.

In the interpretation of the wing veins it is now recognized that the 1A of Comstock and Needham (1898, 1899, *American Naturalist* 32, 33) should, following Snodgrass (1935, *Principles of insect morphology*) be regarded as a separate vein, the *post-cubitus*, while the following anal veins should be distinguished as *vannal* veins. The venational diagrams are marked accordingly; those reading earlier parts of this Revision should make the necessary adjustments.

ZENOPHASSINAE subfam. nov.

ZENOPHASSUS gen. nov.

Plate v, fig. 52; Text-fig. 3-6.

Head with antennae cylindrical, tapering to apex, composed of about 28 segments. A supposed post-antennal organ, composed of a single club-shaped member present at the anterior angle of the clypeus. Mouth parts with mandibles pre-

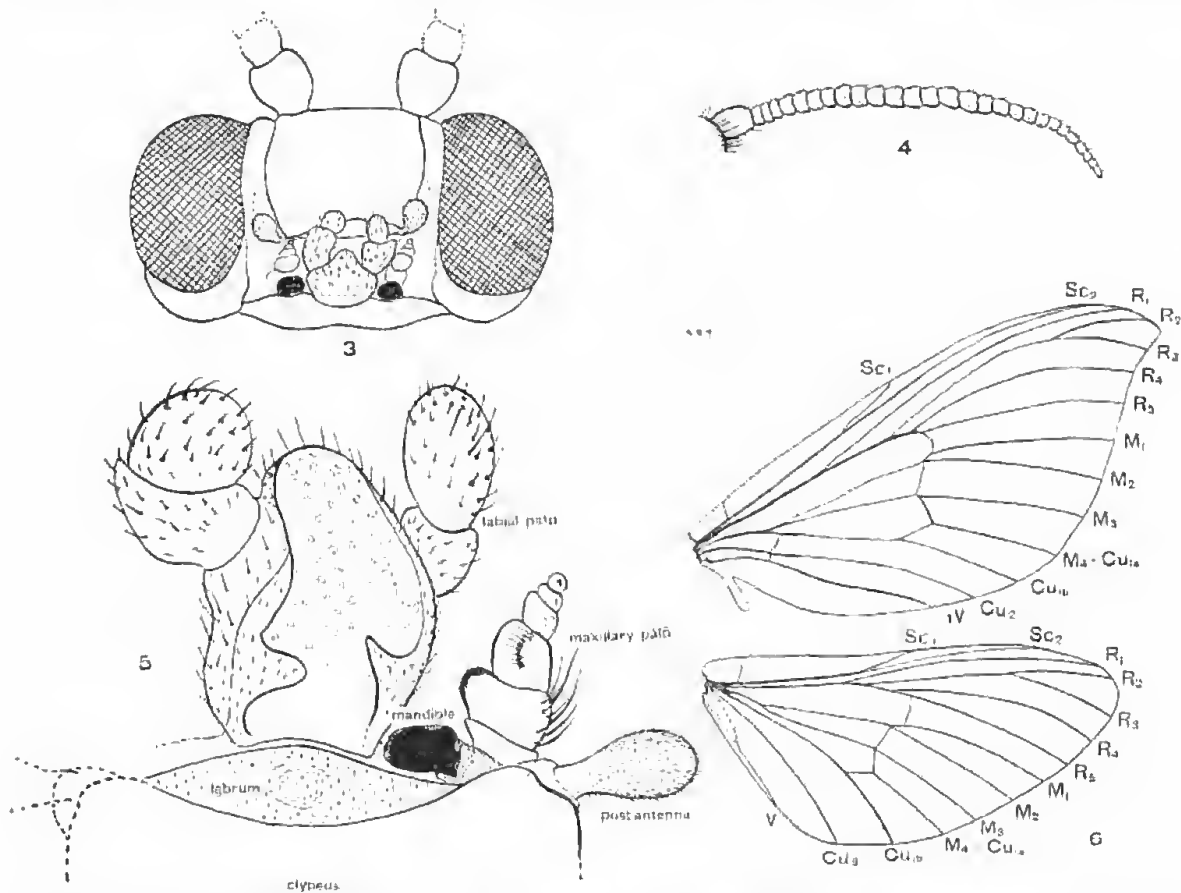


Fig. 3-6. *Zenophassus schamyi* (Christoph), male, Kuban, Caucasus. 3. Ventral view of head. 4. Antenna. 5. Mouth parts from dorsal aspect of hypopharynx. 6. Venation.

sent, rudimentary, but strongly chitinized, some obscure traces of dentition. Hypopharynx large, about as wide as long. Labial palpi two-segmented, occasionally segments almost fused, the division then only visible in microscope mounts. Maxillae present, reduced, at least five visible segments. Posterior legs in male with specialized tibial tuft. Forewings with Sc₁ present as a strong vein; R₁ and R₂ before apex; R₅ well separated from Sc₁; R₂ from R₃ near apex; R₄ from R₅ before r-m vein; Cu₂ a weak vein but reaching to margin; Cu₅ apparently obso-

lete; 1V a strong vein to posterior angle; 2V absent. Hindwing with Sc_1 present as a strong vein to costa; Cu_2 a strong vein; Peu and two vannal veins apparently fusing near base, with 1V extending to hind margin.

Genotype: *Hepialus schamyl* Christoph. (1888, p. 309; 1889, p. 198).

Only one species has so far been recognized in this strange genus which seems to combine one or two specializations usually associated with genera like *Phassus* and *Sthenopsis* with some of the most primitive features yet found in the Lepidoptera. The latter warrant its separation as a new subfamily, the Zenophassinae. The mandibles, apparently non-functional yet rather well developed, and the maxillae, are features which could be expected to occur in a primitive member of this archaic family, although they have only been noticed as traces in such species as *Fraus polypila*. The supposed post-antennal organ, a single club-shaped segment, has apparently not hitherto been found in a lepidopterous insect, although such organs have been recorded for insects of other more primitive orders.

The presence of Sc_1 in both wings is another archaic feature. This vein is (e.g. Philpott 1926) sometimes considered to be absent in the Hepialidae, but may be seen in the forewing of members of several genera, its presence or absence being a useful diagnostic character for genera allied to *Sthenopsis*. In no other Hepialid, so far as they have been examined, does it seem to be so strongly developed as in this genus.

Deegener and Schaposchnikow (Zeitschr. wiss. Zool., lxxviii, pp. 245-260, pl. xiv) have described scent organs present on the posterior legs of the male of *Z. schamyl*, while Slastshevskij (1929, pp. 189-199, fig., 1929a, pp. 39-56 and 1929b, pp. 51-60) has described its biology. The one known species occurs in the Caucasus Mountains, the specimens examined being from Kuban (July), Majkop (Sept.), and Elisabethpol.

Subfamily HEPIALINAE.

ENDOCLITA Felder 1874.

Endoclita Felder, 1874, iv, pl. lxxxii, f. 3. *Endoclyta* Felder, 1875, v, Erklär., p. 4 (*similis*). *Hypophassus* Le Cerf, 1919, xxv, p. 470 (*signifer*), new synonymy.

Antennae sparsely clothed with hairs, cylindrical, short, tapering, with about 22 segments (fig. 7). Labial palpi reduced, composed apparently of a single segment, with some indications of a second marked by a line and not articulated (fig. 8). Posterior legs of male with tibiae clothed with a large tuft of specialized hairs. Forewings with Sc_1 present as a branch to the costa; often a lobular expansion opposite Sc_1 (not evident in genotype); R_1 forking with R_5 well before the middle of wing; R_4 and R_5 forked; Cu_2 becoming obsolete at one-half; Peu and 1V anastomosing beyond middle and extending to margin; 2V present near base. Hindwings with Sc unbranched. R_1 from well before middle.

Genotype: (*Endoclita similis*) Felder = *Phassus damor* Moore.

The spelling of the generic name as *Endoclita* is accepted. This appeared on plate lxxxii of part IV of Felder's work which was published in November, 1874. The "Erklärung" published with part V (about July, 1875) gives an alternative spelling (*Endoclyta*). In the Zoological Record for 1874 and in the supplementary list of new genera, *Endoclita* is disguised under the misprint of *Sudoclita*. The original figure, with generic and specific name as given in 1874, can be accepted as a valid indication according to the International Rules for Zoological nomenclature. (See also Hemming, Generic names of Holarctic Butterflies, 1934, p. 8-9). In Felder's "Erklärung" the brief description "*Endoclyta* n.g. (Epialo

affine; pedeo validi, corpus longum, al. post angulus internus expressus) *similis* F. ♂ Himalaya (Stoliczka)'' gives no reason for an alteration in spelling.

Hypophassus is a valid name but it must be regarded as a synonym of *Endoclitia* unless it is later on established that *E. signifer* can be separated generically from *E. damor*.

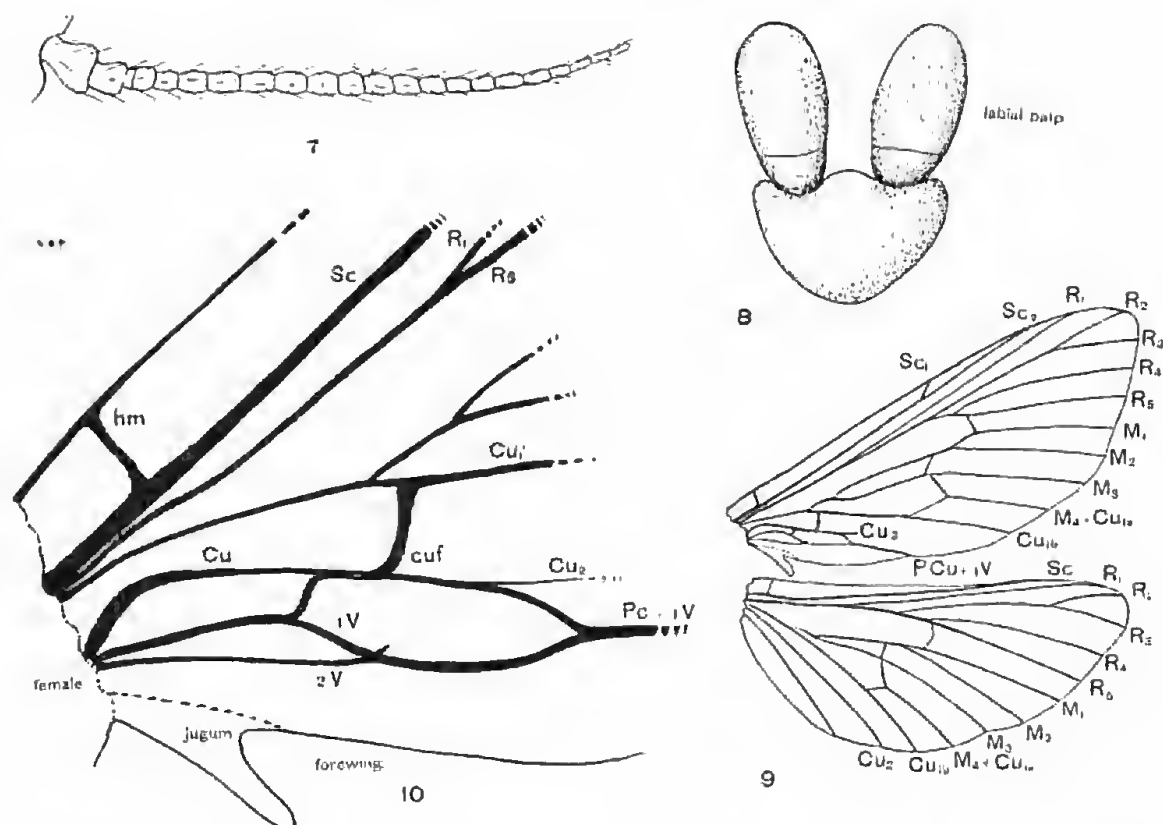


Fig. 7-10. *Endoclitia damor* (Moore), female, Mussoorie. 7. Antenna. 8. Labial palpi. 9. Venation. 10. Venation of portion of forewing (much enlarged).

In the species placed in *Hypophassus* the costa of the forewings at Sc₁ is dilated, forming a lobular expansion; the condition reaches its climax in *E. crenilimbata* Le Cerf, from China, but is well marked in numbers of others, including *E. signifer*. It is absent in the genotype of *Endoclitia*. When present it is about equally developed in the sexes, and may be of generic significance, but in the absence of a well-defined line of demarcation it is difficult to apply. If *Hypophassus* is regarded as a subgenus it will embrace *signifer*, *crenilimbata*, *gmelina*, and other, as yet undescribed East Indian species possessing a swollen costa; *E. chalybeata* is an intermediate form. Fourteen species are at present known from India, Burma, and Ceylon, and several are important timber pests.

Members of a group within this genus, embracing *E. punctimargo*, *buettneria*, *metallica*, *rustica*, *aurata*, and *chrysoptera* appear to have valid specific differences separating them, for in addition to rather striking variations in size, wing proportions, distribution of markings and of "metallic" scalings on the wing, there are observable differences in the genitalia. Nevertheless the genitalia show by their similarity that the differences may be of a lesser order than those separating some other members of the genus. An explanation which occurs to me is that

these represent a complex of relatively lately evolved species, developed in the highlands of the Eastern Himalayas. Other more widely divergent members of the genus may belong to older forms representing survivals from earlier periods of species formation. In the Hepialidae, which are generally considered to be primitive and relatively stable, actively evolving groups may be observed in several different geographical areas, for example in the mountains of Papua, where many diverse, and yet related, forms of *Oxycanus* and of *Oenetus* appear, in the south of Australia (*Oxycanus*, *Oenetus* and *Oncopera*), and in the southern extremity of Africa.

KEY TO PRINCIPAL SPECIES OF ENDOCLITA.

(Based partly on the genitalia.)

- a. Males.
- b. Tegumen with a posterior, ventrally directed spine.
 - c. Spine long, extending beyond rest of tegumen.
 - d. Eighth sternite deeply notched on posterior margin *damor*
 - dd. Eighth sternite not deeply notched on posterior margin .. . *marginenotatus*
 - cc. Spine short, extending no further than tegumen *undulifer*
 - bb. Tegumen without a posterior, ventrally directed spine.
 - e. Posterior margin of eighth sternite with a median projection .. *chalybeata*
 - cc. Posterior margin of eighth sternite without a median projection.
 - f. Tegumen, in lateral view, with margin entire and convexly dilated.
 - g. Margin of tegumen in ventral view diverging posteriorly.
 - h. Posterior margin of tegumen strongly transverse and only slightly excavated *gmelina*
 - hh. Posterior margin of tegumen strongly excavated *purpurescens*
 - gg. Margins of tegumen in ventral view, not diverging posteriorly.
 - i. Seventh sternite deeply notched on posterior margin *signifer*
 - ii. Seventh sternite transverse on posterior margin *albosignata*
 - ff. Tegumen in lateral view with only posterior half dilated,
 - j. Posterior margin of eighth sternite with a median notch *rustica*
 - jj. Posterior margin of eighth sternite transverse, and without median notch.
 - k. Hindwings clothed with metallic scales *metallica*
 - kk. Hindwings not clothed with metallic scales.
 - l. Expanse over 50 mm.
 - m. Forewings chocolate brown *buettneria*
 - mm. Forewings yellowish-brown and golden-yellow *chrysoptera*
 - ll. Expanse under 50 mm, *aurata*
- aa. Females.
 - n. Posterior margin of seventh sternite with deep median notch *undulifer*
 - nn. Posterior margin of seventh sternite without deep median notch.
 - o. Anterior gonapophyses with apical spine. Penultimate tergite with antero-ventral margin produced.
 - p. Eighth sternite narrow, with parallel sides *microscripta*
 - pp. Eighth sternite broad, sides not parallel.
 - q. Seventh sternite much wider than long *punctimargo*
 - qq. Seventh sternite as long as wide *buettneria*
 - oo. Anterior gonapophyses without apical spine. Penultimate tergite with antero-ventral margin not produced.
 - r. Anterior gonapophyses a broad plate, not digitiform.
 - s. Eighth sternite swollen at apex of posteriorly produced portion.
 - t. Eighth sternite narrowly spatulate *signifer*
 - tt. Eighth sternite broadly spatulate *chalybeata*
 - ss. Eighth sternite not swollen at apex.
 - u. Eighth sternite with margins parallel sided *damor*
 - uu. Eighth sternite swollen near base, not parallel sided *purpurescens*
 - rr. Anterior gonapophyses digitiform not expanded into a broad plate *gmelina*

ENDOCLITA DAMOR (Moore).

Plate v, fig. 53-54, and Text-fig. 7-14.

Phassus damor Moore, 1859, ii, p. 437. *Endoclista similis* Felder, 1874, iv, pl. lxxxii, fig. 3. *Phassus damor* Butler, 1886, vi, p. 31, pl. cix, f. 3; Hampson, 1892, i, p. 319; Pfitzner and Gaede, 1933, x, p. 843, pl. lxxvii b.

♂ Antennae pale ochreous; head, sides of thorax and abdomen, pale brown; thorax above slightly paler; hind tibiae ornamented with large tuft of dull ochreous hairs. Forewings pale subhyaline brown, with a dull golden tinge, ornamented with obscure brown, silvery-grey, and white lunular markings; the brown of wing forms a broad oblique zigzag fascia free from silvery markings across discoidal area, starting from costa near base, and running across to termination of

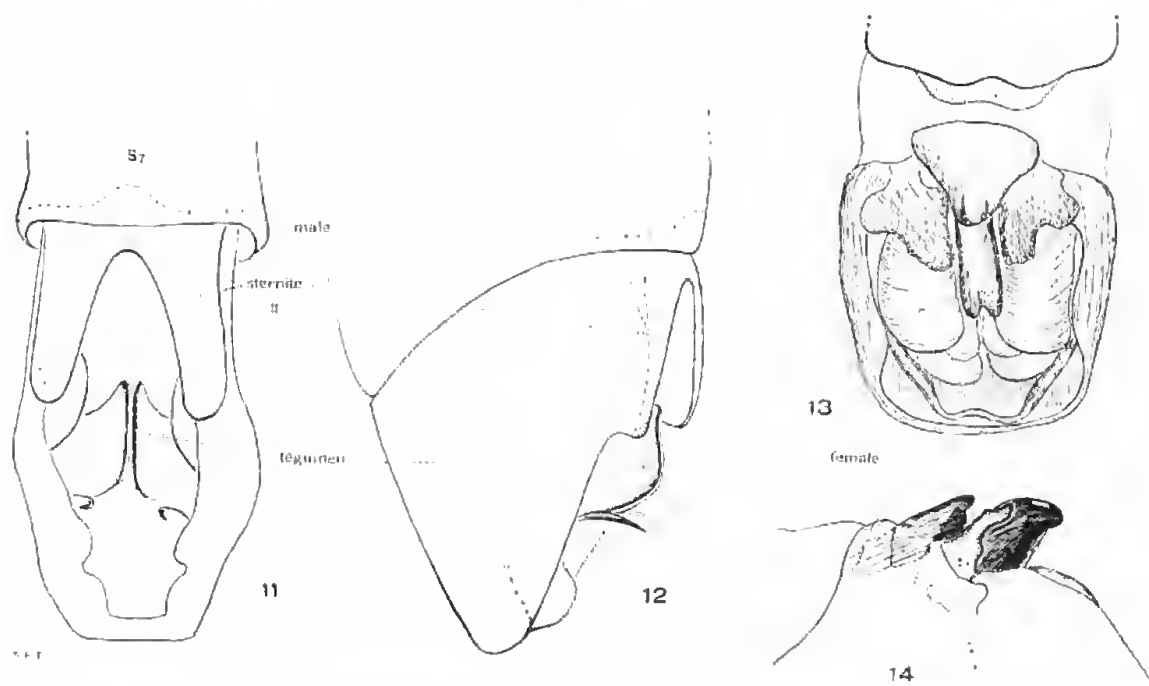


Fig. 11-14. *Endoclista damor* (Moore). 11. Male, Kangra Valley, genitalia, ventral aspect. 12. Male lateral aspect. 13. Female, Mussoorie genitalia, ventral aspect. 14. Female, lateral aspect.

Cn₂ where it is margined below by a clearly defined semi-circle of silvery-white markings enclosing a brown spot, and thence to costa at four-fifths, after making an angle to avoid an obscure triangular wedge of silvery-grey markings at two-thirds costa. Hindwings greyish-brown, darker towards apex, costal margin just before apex tinged with brown and bearing two obscure silvery-grey markings. Expanse 63 mm.

♀ Similar to male, but colour darker olivaceous brown, markings well defined, similar to male. Head and thorax above dull whitish-olivaceous; posterior tibiae without specialized hair tufts. Expanse 68 mm.

Loc. Sikkim: Darjeeling (type a female, expanse 88 mm. labelled "Darjeeling, Paris Exhib. 60-51 E.I.C." in British Museum).

United Provinces; Mussoorie. Punjab; Kangra Valley (4,500 ft.). 6. One male, three females.

The male described is from Kangra Valley, the female from Mussoorie. The differences in colour exhibited between the few examples examined suggests that,

like many Australian Hepialidae, there may be considerable range in the shades of colour present on the wings.

The Mussoorie female, from our collection, has been closely compared with Felder's type of *Endoclita similis* in the Tring Museum. The latter is a female, expanse 63 mm., labelled "India Sept. type *Endoclita similis*, no. 6 in tab. Felder Coll." The no. 6 is evidently an error for "no. 3". The genitalia of this type specimen, as far as may be seen without dissection, agree closely with the one figured.

The type of *damor*, of which Butler's figure is a representation, is also a female; it is larger than our described specimen, but the markings are similar. The genitalia are so badly affected with mould that it was not possible to make a close examination of them. The figure in Seitz is an inferior copy of Felder's plate, and does not greatly resemble the original. Specimens of this species are present in the British, Tring, and South Australian Museum collections.

The male genitalia, which have been examined without dissection (fig. 11-12) have the tegumen, viewed from the side, somewhat evenly convex and smooth margined. There is a long-pointed cylindrical spine rising from its postero-lateral margin. The posterior margin of the eighth sternite is deeply notched, and the postero-lateral extremities are strongly rounded and chitinized.

The female genitalia, also drawn without dissection (fig. 13-14) show a rounded triangular seventh sternite, a strongly chitinized, narrow, straight-sided, end-notched, well-rounded eighth sternite; curious irregular flat, racket-like anterior gonapophyses are present, and the supposed posterior gonapophyses appear as rounded, subglobose, lateral lobes.

ENDOCLITA MARGINENOTATUS (Leech).

Plate vii, fig. 68 and Text-fig. 15.

Phassus marginenotatus Leech, 1898, p. 356.

The type of this species is figured, together with a representation of the male genitalia for comparison with species such as *E. chrysoptera*, which is superficially similar. The type example in the British Museum is from Western China and is labelled "Omei-Shan 3,500 feet, native collector, June and July, 1890, Leech Coll. 1900-64".

I am indebted to Mr. W. H. T. Tams for the photograph (pl. vii, fig. 68) and for his confirmation of my opinion that this species belongs to *Endoclita*. He wrote (13th Dec., 1937): "In *marginenotatus*, the venation is almost identical with that of *P. signifer*. Vein 3A in the forewing seems very weak, but I have looked at a specimen you labelled *Phassus signifer* and I saw that the condition was similar. There seems to be only a minor point of difference, and that is the slope of Sc₁ in the forewing. This is much more acute in *P. signifer*."

The male genitalia (fig. 15) have the tegumen, in lateral view, evenly rounded and there is a posterior, ventrally produced, long cylindrical spine of characteristic shape.

ENDOCLITA UNDULIFER (Walker).

Plate v, fig. 55 and Text-fig. 1-2, 16.

Phassus undulifer Walker, 1869, p. 102. *Phassus signifer* Hampson, 1892, i, p. 320 (*nec* Walker). *Phassus damajanti* Pfitzner and Gaede, 1933, x, p. 843, pl. lxxvi d.

♂ Head, thorax, abdomen, and legs dull ochreous brown. Forewings slightly acute at apex, costa not dilated, dull ochreous brown with darker markings; a rich

brown, highly characteristic undulating mark from near apex to near base; traces of dull silvery-white marks, a large one at r-m vein, several near junction of M and Cu, and small ones among M_1 and near apex. Hindwings dull greyish-brown, a narrow ochreous suffusion along termen from apex, most evident at hinder angle, where it terminates rather abruptly. Expanse 56 mm.

♀ Similar to male, larger, silvery-white spot just before r-m vein well defined. Expanse 84 mm.

Loc. United Provinces: near Benares (type, a female; expanse 92 mm., labelled "Benares, John Graham, 1935-288" in British Museum). Sikkim: Senchal Range, Darjeeling 8; Assam: Khasia Hills 10 (allotype male 1, 18937 in S. Aust. Museum); Upper Burma: Nauhlaing Res. Shwebo, 9, 10. Seven males, seven females.

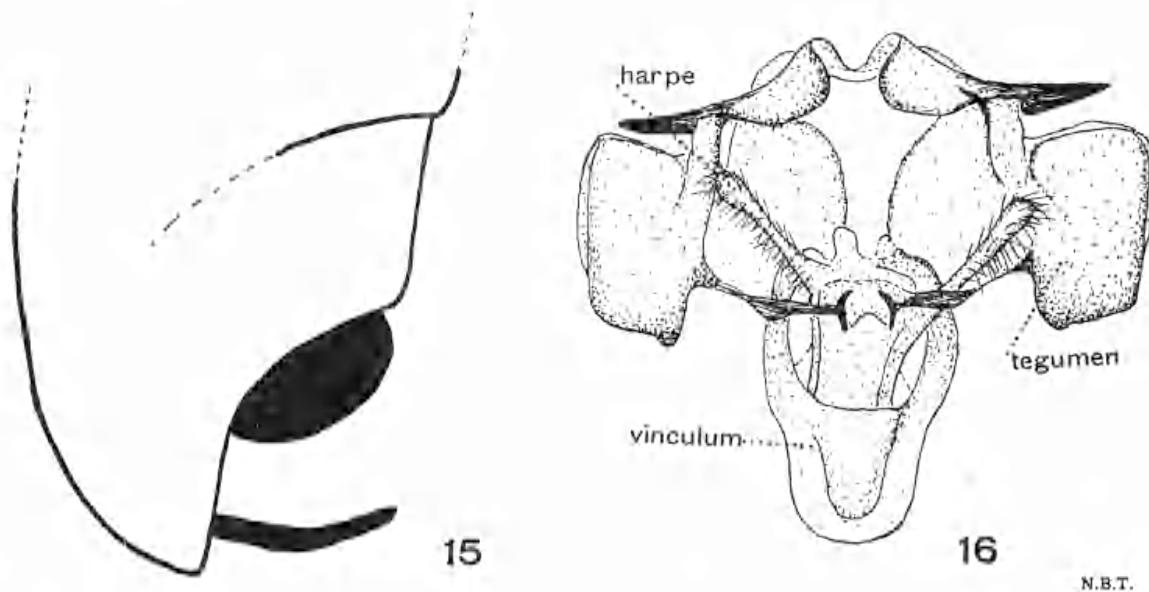


Fig. 15-16. 15. *Endoclyta marginicolatus* (Leech), male genitalia, lateral view, from a freehand sketch of type in British Museum. 16. *Endoclyta undulifer* (Walker), Shwebo, male genitalia, dissected, ventral view.

The type of this species was for many years in the Devon and Exeter Albert Memorial Museum, but in 1935 it passed into the British Museum collection.

The species is a distinct one, and has nothing to do with *E. signifer*, under which name Hampson, in the absence of the type, sought to place it.

The type of *damajanti*, a female expanding 72 mm. from the Khasia Hills, in the Senckenberg Museum, indicates the name is a direct synonym. Unfortunately the figure in Seitz is scarcely recognizable. The example is much worn, but agrees in markings and in the structure of its genitalia with typical material of *E. undulifer* in our collection.

Specimens of *E. undulifer* are preserved at the British, Tring, Senckenberg, and South Australian Museums.

The posterior legs of the male of this species, unlike other members of the genus, lack the specialized tuft of golden-coloured tibial plumes. It thus stands a little apart from its congeners, but it seems undesirable to use this secondary male sex character for generic separation, especially as in other respects it is too close to warrant separation.

The male genitalia (fig. 16) have the tegumen divided into a sub-quadrate, anterior, dilated portion with smooth edges, and a separate strongly chitinized, ventrally produced posterior spiny process, which does not project beyond the

line of the rest of the tegumen; in dissected genitalia the harpes are seen as simple digitiform lobes, swollen at the apex, and bearing sensory hairs; the vinculum is of usual form.

The female genitalia are drawn in slightly diagrammatic manner in fig. 1-2, which are composites built up from observations on two specimens. The seventh sternite is sub-rectangular with a deep notch on the posterior margin; the eighth sternite has its posterior margin produced into an acute median spine; the anterior gonapophyses are angled spine-like processes; the posterior gonapophysis is a fat lamellate member, which is followed by several less well-chitinized folded plates forming the lateral gonapophyses. The following reared specimens have been submitted for determination by the Forest Research Institute, Dehra Dun:

F.R.I. LIST No.	Loc.	SEX.	DATE.	HOST TREE.
27	Darjeeling	Male	2nd August, 1923	<i>Alnus nepalensis</i>
17	Shwebo, Burma	"	3rd October, 1936	<i>Buettneria pilosa</i>
18	" "	"	5th October, 1936	<i>Buettneria pilosa</i>
19	" "	"	1st October, 1936	<i>Buettneria pilosa</i>
20	" "	"	29th September, 1936	<i>Buettneria pilosa</i>
28	" "	Female	12th October, 1936	<i>Buettneria pilosa</i>
25	" "	"	28th September, 1935	<i>Callicarpia arborea</i>

ENDOCLITA CHALYBEATA (Moore).

Plate v, fig. 58-59 and Text-fig. 17-20.

Phassus chalybeatus Moore, 1879, p. 412. *Phassus signifer* Hampson, 1892, i, p. 320, fig. 219 (*partim*).

♂ Head, thorax, abdomen, and legs pale yellow; posterior legs with tibiae ornamented with large tufts of ochreous hairs. Forewings with costa not markedly swollen at Sc_1 ; yellowish-brown with white suffusions; a series of six brown spots along costa; the middle of wing is occupied by a large brown area which partly encloses, at one-third, a sub-costal paler area, posterior to vein Cu_{1b} , which is suffused whitish-buff; a large brown area in discoidal region and another from costa near apex to Cu_{1b} are margined with obscure arcuate marks; there is a white streak at r-m vein and traces of another just beyond it. Hindwings pale flesh-coloured, with traces of a paler mark on costa before apex. Expanse 80 mm.

♀ Slightly paler and duller in colour than male, markings slightly more defined, brown areas reduced, and white suffused areas somewhat larger; the white spot parallel to r-m vein larger, with traces of another on each side of it. Expanse 82 mm.

Loc. Sikkim: Darjeeling (type, a female, expanse 83 mm., labelled "Darjeeling, Moore Coll. 94-106" in British Museum. Assam: Khasia Hills 3 (allotype male, l. 18935 in S. Aust. Museum), Sylhet 3. Burma: Nanttu 5. Sandoway 4. Katha 4. S. Toungoo 5. Five males, seven females.

Moore's type, when examined in 1936, was found to have lost the abdomen; the Darjeeling female example described herein compares so well in other respects that the genitalia of it may be regarded as typical of the species.

The example figured by Hampson as the male of *E. signifer* may be a male of this species. It has nothing to do with true *E. signifer*. Unfortunately Hampson's specimen could not be found when examining the British Museum collections. It appears desirable therefore to describe as allotype male of *E. chalybeata* an example from Assam, which can be confidently associated with the type female, and the genitalia of which may be studied.

Fig. 18 is of the apex of the abdomen of the neo-allotype male, and fig. 17 shows a slide preparation of the genitalia of another example from Katha (Mohnyin). The genitalia are seen to have the eighth sternite shield-shaped and

the posterior margin slightly concave on each side of the middle, which is slightly acutely terminated. The tegumen bears many serrations, rather evenly set and posteriorly directed; the harpes are reduced to simple, small, irregular, hair-beset digitiform processes. The ultimate tergite is bluntly rounded.

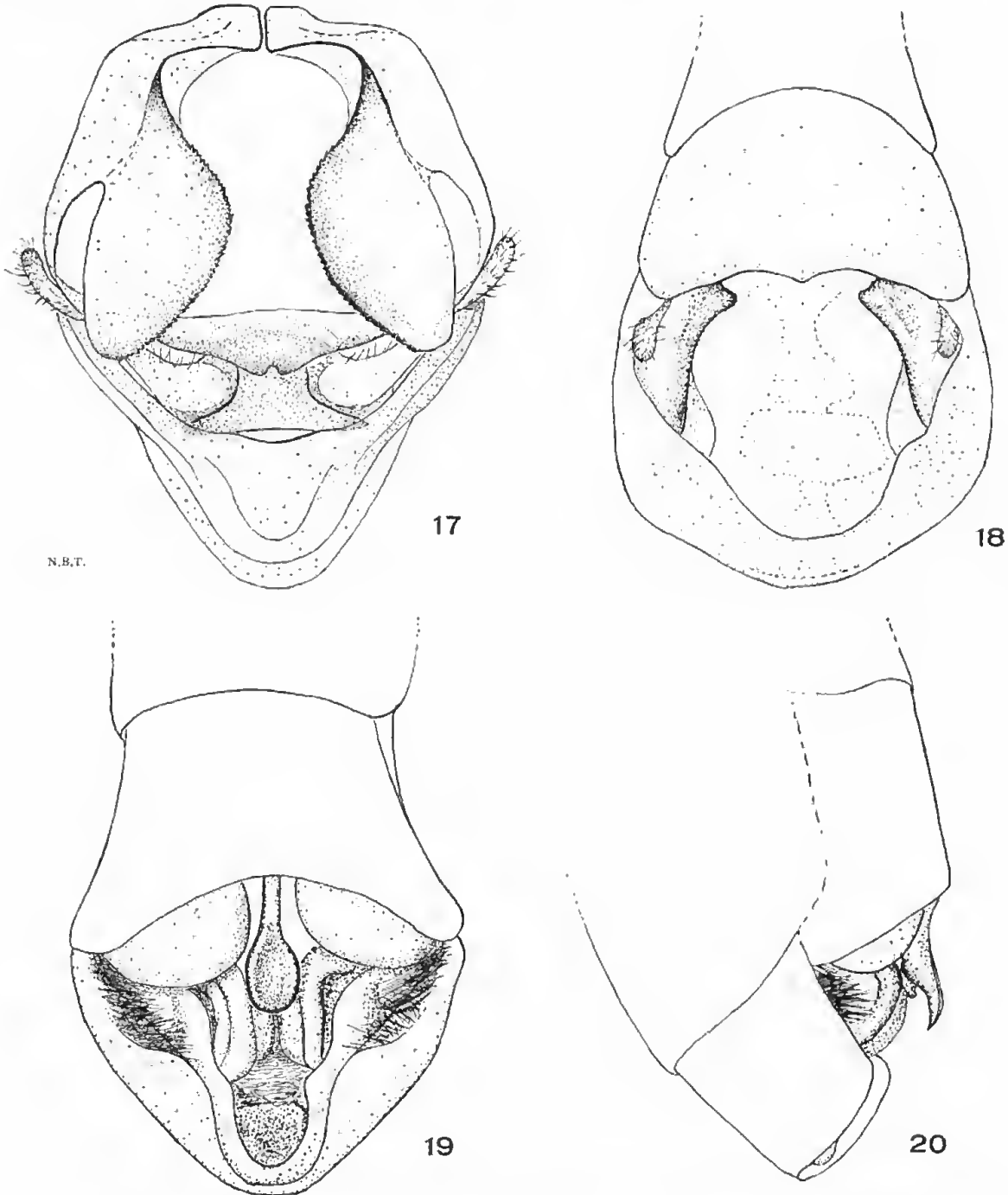


Fig. 17-20. *Endoclyta chalybeata* (Moore). 17. Male, Mohnyin, genitalia, dissected, ventral aspect. 18. Male, ventral aspect *in situ*. 19. Female, Darjeeling, genitalia, ventral aspect. 20. Female, lateral aspect.

From *E. signifer*, with which it has been confused, the male differs widely in the form of the posterior margin of the eighth sternite, in the differently shaped tegumen, in the absence of a carina on the harpes, as well as in the blunter appearance of the ultimate tergite.

The female genitalia (fig. 19-20) have been drawn from the described specimen, without dissection. The posterior margin of the seventh sternite is produced into a strongly chitinized spatulate process which is slightly concave on its ventral surface, and in lateral view is seen to be acutely pointed. The anterior gonapophyses are rounded plates; the posterior ones are carinate rounded lobes, while the ultimate tergite forms a double hood over the genitalia.

In the largest female examples examined, the eighth sternite appears to be hypertrophied as compared with more typical examples. This is probably a case of relative enlargement due to positive heterogonic growth of the female genitalia.

A pupal shell of a female of *E. chalybeata* has been preserved, but unfortunately lacks the facial mask; it is 67 mm. in length, 11 mm. in diameter, and of typical Herialid form.

A fertilized example of the egg of this species was found attached at the opening of the oviporus of the described female example. When relaxed in dilute caustic soda it measured 0.58 mm. in diameter, was spherical, smooth, and slate-grey in colour.

E. chalybeata is of importance as a pest of young teak saplings, and has been reared from *Tectona grandis* and *Gmelina arborea*.

Up to the present this is the only species known to attack teak wood in Burma and Assam. The superficially similar but generically distinct *Sahyadrassus malabaricus* (Moore, 1879, p. 40, new combination) is also a teak feeder, but is strictly confined to the Western Ghats.⁽²⁾

At present a belt of dry country some 600 miles wide divides the areas occupied by the two forms. Only one species of Herialid is common to both regions, and it is evident that the separation between the Herialid faunas of the Himalayas and the Western Ghats must have been a long one. It is of some academic interest to speculate why these two superficially similar species, both teak feeders, should be so alike and yet structurally distinct.

If the loss of Sc_1 in *Sahyadrassus malabaricus* is a specialization we may conclude that *E. chalybeata* represents more nearly an ancestral form (or archetype) from which both *S. malabaricus* and *E. chalybeata* may have been developed, and that the time interval since the two faunules last commingled has been sufficiently long for differences of generic rank to have become established. I have been informed that this is also true of other borers of teak; Malayan and Himalayan species do not extend into the Peninsula. It would be interesting to see whether some differences may not also occur in the host plant species of teak inhabiting these two areas; the systematic botanist seems at present to regard them as being specifically identical.

ENDOCLEITA GMELENA sp. nov.

Plate vii, fig. 72 and Text-fig. 21-22.

♂ Head, thorax, anterior legs, and abdomen dark greyish-brown, sides of thorax black, fringes of anterior legs and the median and posterior legs brownish-black; posterior legs with an ochreous tibial tuft. Forewings broad, falcate, costal margin strongly expanded at Sc_1 ; brown with darker markings and suffusions, a series of about six markings along costa; a very dark patch near base of discoidal area enclosing two silvery-white spots the larger of which is bi-sectioned by M_{1+2} ; posteriorly from this and just above and beyond distal junction of 1A and 2A is a V-shaped black spot from which a dark suffused area extends to the r-m vein

(2) *Sahyadrassus* is a new genus, in which Sc_1 of forewing is absent; the forewings have R_4 separate from R_2 ; R_4 and R_5 branching before or at the r-m vein and Pcu forming a Y fork with the vannal vein. Genotype *Phassus malabaricus* Moore. The genus will be more fully described in Part V.

where there is a cluster of three silvery-white spots; pale ochreous spots of small size lie in two irregular series parallel to and inwards from termen, while a dark suffused longitudinal streak lies between R_5 and M_1 , and runs nearly to termen where it terminates at a small silvery-white spot. Hindwings wide, short, very shortly subfalcate at apex, greyish-brown with traces of brown markings along termen and at the apex. Forewings beneath with costal markings as above; those of hindwing even more pronounced than above. Expanse 90 mm.

♀ Larger than male; markings and colour similar; the black V-shaped mark of forewing broken into a series of three spots, two of them conjoined. Expanse 122 mm.

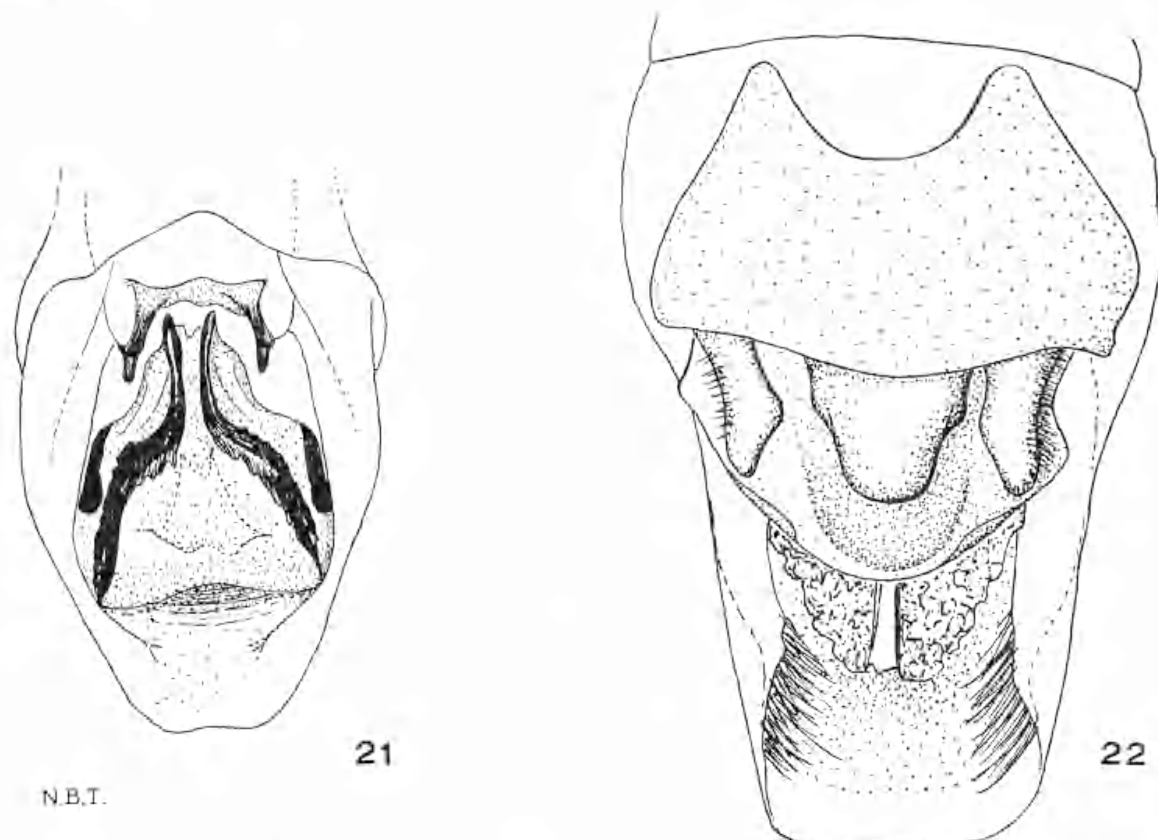


Fig. 21-22. *Endoclita gmelina* Tindale. 21. Paratype male, Panyhai, genitalia, ventral aspect. 22. Allotype female, Panyhai, genitalia, ventral aspect.

Loc. Burma: Panyhai Res. Namtu 5 (type, a male, 22 May, 1931, and allotype female, 10 May, 1931, collected by M. H. Desai, in British Museum; paratype male, 13 May, 1931, I. 18950 in S. Aust. Museum). Two males, one female. The three known examples were reared from *Gmelina arborea* at Namtu.

Another species sometimes found in *Gmelina* wood is *E. chalybeata*. From this it differs widely in proportions, in the colouring of the wings, and in the form of the genitalia. The species is apparently not close to any other described one.

In both sexes of this species the costal expansion at Sc_1 is very marked. In this character it is closest to *E. signifer*, from which it is otherwise distinct; it may also be compared with *E. crenilimbata* from China.

The male genitalia, drawn without dissection (fig. 21) have the vinculum furnished with cylindrical, posteriorly directed processes, one on each side; the tegumen is a curious shovel-shaped object, wide posteriorly, narrow anteriorly, with its ventral margins strongly chitinized and rather irregularly formed. There is a strongly chitinized lateral piece on the outer margin of the tegumen. Super-

pecially the tegumen is similar to that of *E. purpurescens*, but it markedly different in details.

The female genitalia (fig. 22) are extraordinarily different from those of other described members of the genus; the seventh sternite is transverse, the anterior margin bent into a notched fold (which may be accentuated in the dried specimen) while the posterior margin is slightly convex; the eighth sternite is a convex rounded median process which appears to lie ventrally from a broad, much larger chitinized plate, concave in ventral view and with the side portions of its posterior margin bent over; this may be a further portion of the eighth sternite; the anterior gonapophyses are digitiform processes, angled before the apex and with the lateral margins beset with stout hairs (as on the internal margins of the male harpes of many species of Hepialidae). To satisfactorily determine the homologies of the posterior parts of the genitalia it would be desirable to have further material for dissection.

ENDOCLITA PURPURESCENS (Moore).

Plate v, fig. 56-57, and Text-fig. 23-26.

Phassus purpurescens Moore, 1883, ii, p. 156, pl. exliii, f. 4. *Phassus purpurascens* (sic) Hampson, 1892, i, p. 319. *Phassus purpurascens* Pfitzner and Gaede, 1933, x, p. 843, pl. lxxviii d.

♂ Head, thorax, abdomen, and anterior and median legs dull brown with a faint purple tone, posterior legs with tibiae clothed with tufts of deep orange-coloured hair. Forewings dull brown with a purple tone (probably somewhat brighter in freshly-captured specimens); faint brown lunulate markings cover greater part of wing, except in a broad, brown, irregular band across discoidal region and a less well-defined strip running across from four-fifths costa to near hind margin; a yellowish-white spot just inside r-m vein and two minute ones external to it; another near base of wing; a series of minute black spots along costa, and several others near the posterior margin. Hindwings slightly darker than forewings, unicolorous greyish-brown with a faint purple tinge. Wings beneath pale uniform greyish-brown. Expanse 94 mm.

♀ Markings similar to male; the broad oblique brown band across discoidal region of forewing terminates in a clear-cut line near hinder margin with an L-shaped angular band of very pale purplish-brown; the posterior legs are not ornamented with orange plumes, and are unicolorous with the other pairs. Expanse 118 mm.

Loc. Ceylon (type, a female; expanse 112 mm., described as a male, labelled "Phassus purpurescens Moore type" 52-62, in British Museum); Punduloya 5, 6; Maskeliya 1; Haputale 1; Dimbula 4. Four males, 10 females.

The species appears to be confined to Ceylon; the Perak record by Hampson is doubtful. Specimens are to be found in the British, Tring, Colombo, and South Australian Museums. Examples identified as this species at the Berlin Museum belong to other species.

Moore's type proves to be a female; at the time of its first description it was unique. His figure differs from the type only in the greater emphasis placed on the costal markings of the forewing; this is probably an artist's error for, in other respects, it is a good figure of the type specimen. The figure in Seitz *Macrolepidoptera* (le. pl. lxxviii d) does not resemble the type in any particular, and may apply to one of the numerous Malayan species of this genus.

The venation of the male agrees closely with that of *E. damor*. Sc_1 is present in the forewing, but absent in the hindwing. There is no expansion of the costa at Sc_1 . The posterior legs of the male are clothed with a large tuft of specialized orange-coloured hairs; these are absent in the female.

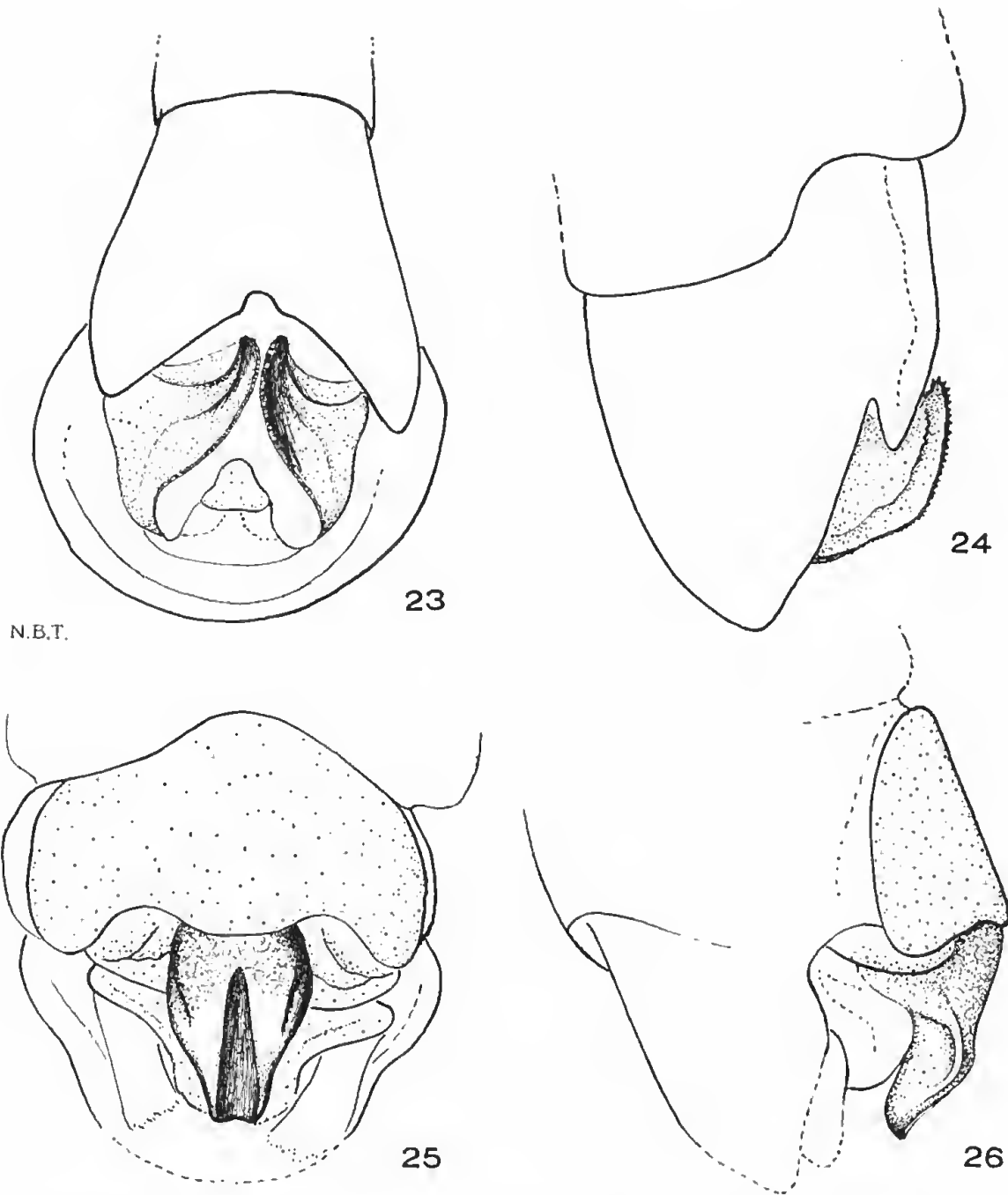


Fig. 23-26. *Endoclyta purpurescens* (Moore). 23. Male, Punduloya, genitalia, ventral aspect. 24. Male, lateral aspect. 25. Female, Ceylon, genitalia, ventral aspect, extremity broken off. 26. Female, lateral aspect.

From an oblique angle the hindwing appears to be tinged with a purple sheen, hence the name *purpurescens*; this feature is not nearly so well displayed as in some of species from Malaya, which have been confused with it.

I am indebted to the Director of the Colombo Museum (P. P. Deraniyagala) for study material.

The male genitalia (fig. 23-24) have the posterior margin of the eighth sternite concave and further notched in the middle; the tegumen, viewed from the side, is evenly rounded, with its entire margin armed with fine teeth, a line of less

evident serrations forms a carina on outer surface of the tegumen; this line fades away posteriorly. The harpes are not apparent in the undissected specimen.

The female genitalia, in the one example available for drawing (fig. 25-26) have the seventh sternite somewhat like an inverted shield, the posterior margin being concave on each side of the middle; the eighth sternite is large and bulbous with a median ventral groove; it is also notched along the side; the bases of what are probably the anterior gonapophyses are visible and appear to be dilated towards their apices.

ENDOULITA SIGNIFER (Walker).

Plate vi, fig. 60-61 and Text-fig. 27-30.

Phassus signifera Walker, 1856, vii, p. 1568; Butler, 1886, vi, p. 30, pl. cix, fig. 2; Hampson, 1892, i, p. 320 (*partim*). *Hypophassus signifera* Le Cerf, 1919, xxv, p. 470. *Phassus signifera* Pfitzner, 1912, Seitz Macrolep, ii, p. 438, pl. liv a; 1933, x, p. 842 (*partim*).

♂ Head, thorax, anterior and median legs ochreous brown, abdomen dark greyish-brown, ochreous-tinged at apex, posterior legs reduced in size, ochreous, ornamented with specialized tuft of bright ochreous hairs. Forewings with costa swollen at Sc_1 , apex sub-falcate, ochreous-brown with whitish-brown suffusions, seven rounded brown spots along costa, arranged in three pairs and margined narrowly with black and pale brown rings; a broad V-shaped patch of brown with its apices touching Sc at one-quarter and at three-fifths and enclosing, near each apex of the V, one or more white spots, narrowly margined with dark brown; sub-terminal and hind marginal areas paler, marked with transverse brown lines between the veins, and with obscure, usually paired tiny black spots. Hindwings dark greyish brown on basal half, costal margin with pattern as on forewings, termen dull brown with traces of the forewing pattern. Expanse 105 mm.

♀ Markings somewhat as in male but rather more conspicuous; ground colour dull olivaceous-brown with pale brown areas well defined. Hindwings with base suffused with greyish-brown pubescence, apex marked as in forewing; these markings merge posteriorly into a series of obscure dull greyish-brown patches running parallel to termen. Expanse 120 mm.

Lac. Assam: Sylhet (type, a female; expanse 154 mm., labelled "Silhet, 47-96" in British Museum); Khasia Hills (allotype male I. 18934 in S. Aust. Museum); Jaintia Hills; Cherrapunji. Nine males, 11 females.

The swollen costa at Sc_1 of forewing is noteworthy, and reappears in several Indian, Malayan, and Chinese species. If sub-generic division is desired, this species may be placed in *Hypophassus*.

The figured male is the allotype, and the female is a second example from Khasia Hills also in the S. Aust. Museum collection.

Walker's type of this species, of which Butler's figure is a good rendering, is a female from Sylhet; our example is smaller but agrees closely in other details. The other specimens associated with the type of *E. signifera* by Walker himself are not con-specific, and there has always been considerable doubt and confusion about the identity of the species. A review of the earlier literature shows that at one time or other most of the common Oriental species of the composite *Phassus* group have been regarded as synonyms under the name.

E. signifera is distinct from all other members of the genus by the combination of the sub-falcate forewings, repetition of portion of the pattern of the forewing on the hindwing, and by the peculiar genitalia. Hampson appears to have been confused about this species, and the figure given by him agrees best with that of the male of *E. chalybeata*.

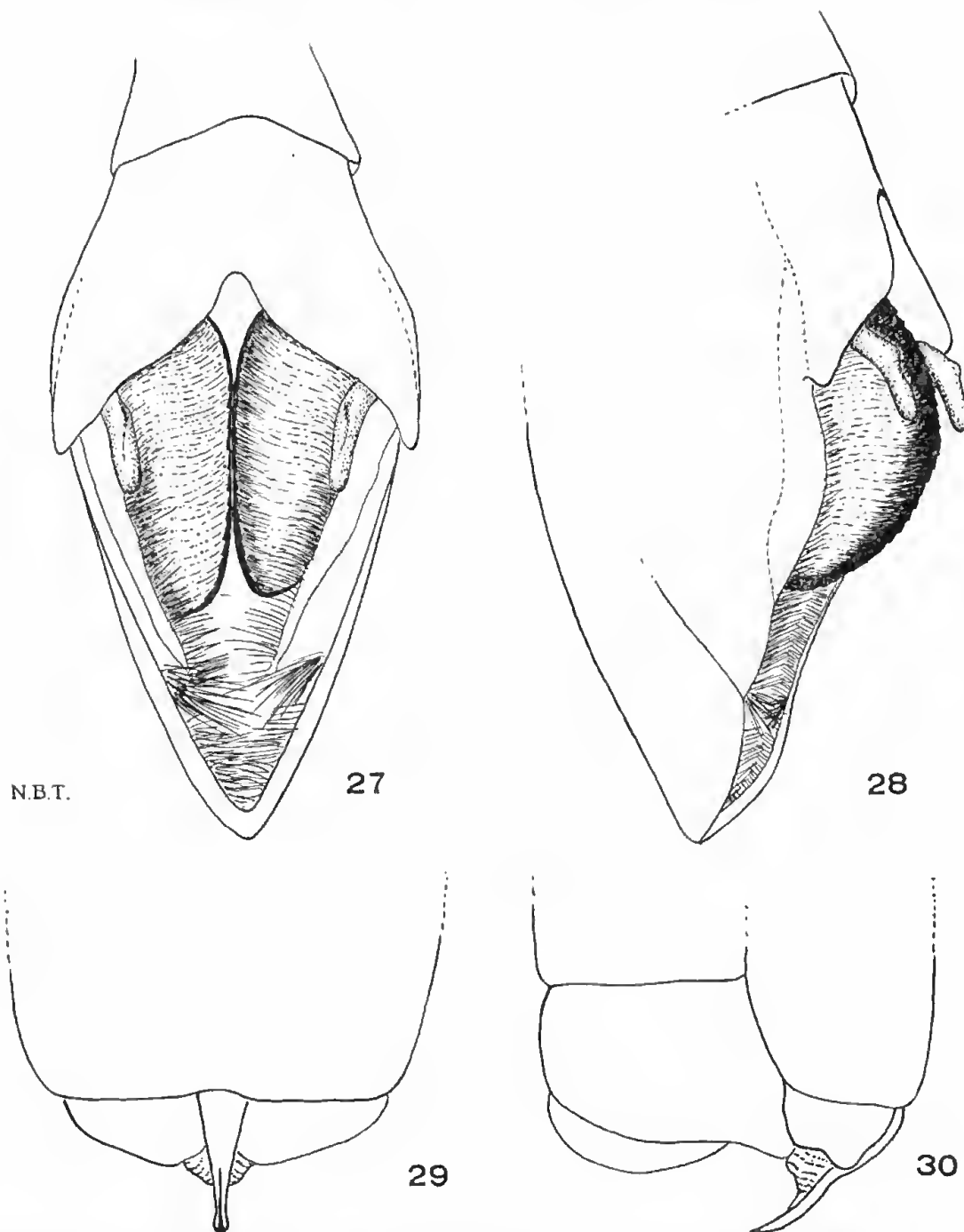


Fig. 27-30. *Endoclista signifer* (Walker). 27. Allotype male, Khasia Hills, genitalia, ventral aspect. 28. Allotype, lateral aspect. 29. Type female, Sylhet, genitalia, ventral aspect. 30. Type female, lateral aspect.

In Seitz Macrolepidoptera, Pfitzner has copied Butler's figure of the type female. Following Hampson, he and Gaede have grouped as races several rather widely different Oriental species, some belonging to the *Endoclista* series without the costal swelling, and others belonging to the subgenus *Hypophassus* in which the costa is expanded at Sc_1 . It is the writer's present opinion that *E. signifer* is a species confined to Assam, and that no races have yet been established to exist outside India.

The male genitalia, examined *in situ* in the allotype male (fig. 27-28) have the harpes as a simple, slightly angled, smooth, cylindrical process with traces of a

carina on the ventral surface. The tegumen in lateral view is evenly convex, the margin slightly bent outwards and irregularly serrated; serrations fine; the posterior margin of the eighth sternite is excavated in wide V-fashion.

The species is represented in the British, Senckenberg, Tring, and South Australian Museums.

The genitalia of the type female have been drawn, without dissection (fig. 29-30). The seventh sternite has the posterior margin transverse and scarcely notched in the middle. The eighth sternite is produced into a long, tapering, up-turned process; its ventral side is grooved apically where it ends in a slight spatulate swelling. Nearer the base the process is seen to be produced laterally as a thin membrane which is folded into several transverse rugae. The anterior gonapophyses take the form of flat lateral plates, with sinuate apical margins, which partly overlie the rugose part of the eighth sternite. The posterior gonapophyses are large, strongly chitinized, rounded, swollen plates.

ENDOCLITA ALBOSIGNATA sp. nov.

Plate vi, fig. 62 and Text-fig. 31-32.

♂ Head, thorax, abdomen, and legs pale brownish-fawn; posterior tibiae with orange-brown tufts of hairs. Forewings brownish-fawn with paler suffusions and traces of numerous scattered white spots faintly margined with dark brown; a

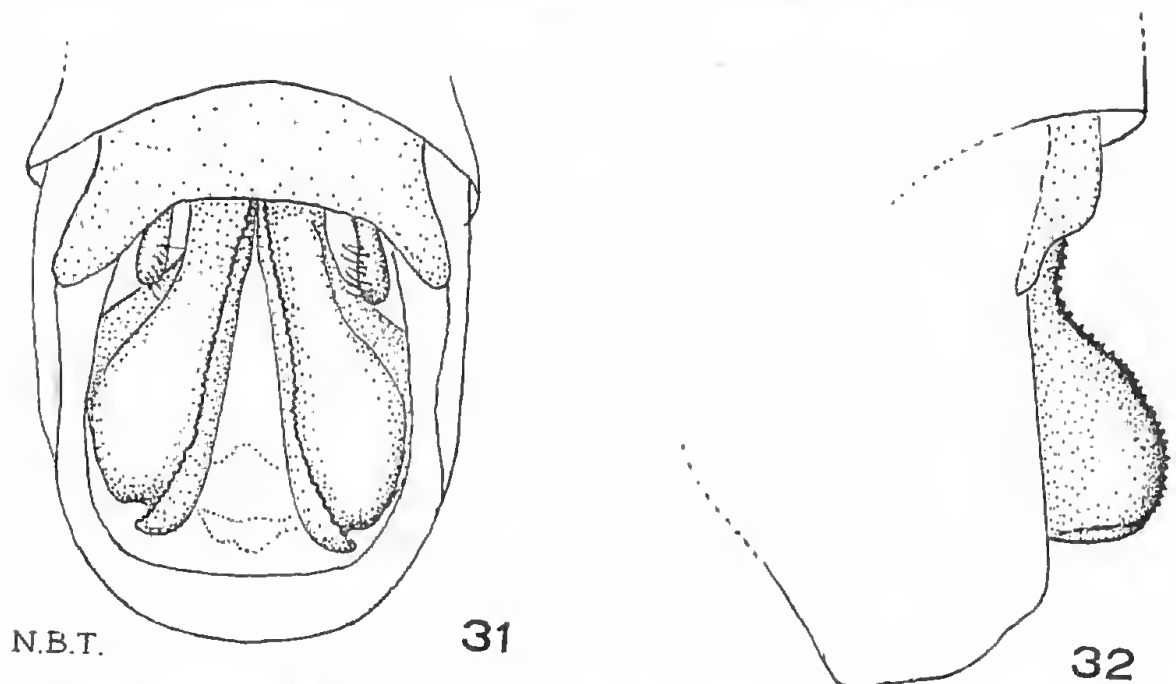


Fig. 31-32. *Endoclita albosignata* Tindale. 31. Type, a male, unique, Assam, genitalia, ventral aspect. 32. Male, lateral aspect.

white inverted T-shaped mark along M_1 and r-m vein. Hindwings dull greyish-brown with costal margin and termen brownish-fawn. Expanse 68 mm.

Loc. Assam: type, a male, unique I. 18942, in S. Aust. Museum.

This species differs markedly from its congeners. In the general form of the tegumen it is nearest to *E. signifer*, from which it differs in the absence of the costal expansion of forewing and in many other characters. With its rather narrow wings it is at first glance like *Sahyadrassus albofasciatus* (Moore, 1879, p. 413), but the presence of Sc_1 in forewing and an examination of the genitalia immediately separates them.

The male genitalia, drawn without dissection (fig. 31-32) show the eighth sternite with the posterior margin transverse, the tegumen, in lateral view expanded, and with the anterior two-thirds evenly convex, the posterior portion somewhat abruptly angled, and the ventral margin slightly turned outwards and freely and evenly serrated; in ventral view the sides of the tegumen are seen to be swollen, smooth and with a lateral carina; the harpes are present, digitiform and clothed with reversed hairs on their internal faces.

ENDOCLITA RUSTICA sp. nov.

Plate vi, fig. 63, 66, and Text-fig. 33.

♂ Head and thorax rich brown, antennae and legs darker; abdomen dull grey; posterior tibiae with ochreous yellow tufts. Forewings rich brown with golden-brown suffusions and traces of many short transverse dark brown streaks between the veins; traces of some white spots along termen and along outer half

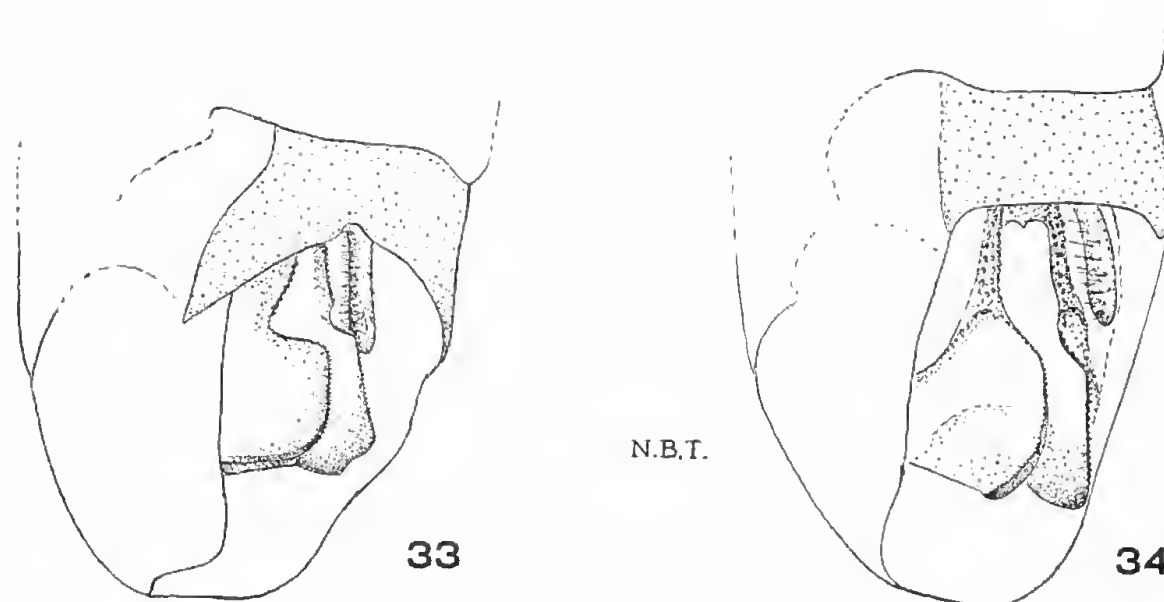


Fig. 33-34. 33. *Endoclitia rustica* Tindale, type, a male, Shillong, genitalia, oblique aspect. 34. *E. metallica* Tindale, type, a male, Darjeeling, genitalia, oblique aspect.

of IV; traces of a golden-brown suffusion in a band from near base to termen at one-half. Hindwings dull grey, at apex narrowly tipped brown. Expanse 56 mm.

Loc. Assam: Shillong 9 (type, a male, 1. 18943, in S. Aust. Museum) Khasia Hills (paratype male in Tring Museum). 2 males.

This rather distinct species, with its rich chocolate brown forewings and dull grey hindwings, is one of a group of allied species inhabiting the wet rain forests of Upper Assam and the Himalayas, and is more especially related to *E. chrysoptera*, from Sikkim. From the latter it differs in the narrower forewings, different coloured hindwings, and in the shape of the eighth sternite.

The male genitalia (fig. 33) have the posterior margin of the eighth sternite concave, and slightly notched in the middle; the tegumen has the posterior half dilated into a subrectangular lamella whose margin is serrated.

ENDOCLITA METALLICA sp. nov.

Plate vii, fig. 71 and Text-fig. 34.

♂ Head, thorax, and legs dark chocolate brown, posterior tibiae with orange-yellow tufts; abdomen dull brown. Forewings chocolate brown with traces of darker transverse bars between the veins; two large dark brown suffused spots, one along course of M_1 before r-m and one just after; a white scaled triangular spot at junction of r-m vein and M_1 ; from a very oblique angle two opalescent blue fasciae appear, the first from near apex to hind margin at four-fifths, the second from costa at three-fourths parallel to its as far as Cu_{1b} ; the hind margin broadly tinged with same hue. Hindwings greyish-bronze with a strong metallic lustre. Expanse 54 mm.

Loc. Sikkim: Darjeeling (type, a male, "Darjeeling No. 69 Atkinson Coll." in Tring Museum; paratype male, *ditto*, I. 18944 in S. Aust. Museum). 2 males.

I am indebted to Dr. K. Jordan for permission to describe this species; the two known examples have had a varied history, having been incorrectly identified, at various times, as *Phassus punctimargo* Hampson and as *P. aboe* Moore. They passed from the Atkinson collection to Elwes and thence to Tring. The species is related to *E. rustica*, but differs in the dull metallic bronze lustre of the scaling of the hindwings, in the dark chocolate colour of forewings and in the relatively transverse eighth sternite as well as the similar, but differently armed tegumen. The paratype has the forewings darker than the type, but is otherwise similar.

The male genitalia (fig. 34) have the eighth sternite transverse and its posterior margin straight; the tegumen has the posterior half dilated into a lamella, portion of the serrated ventral margin of which is bent outwards; the serrations and denticules on the anterior half of tegumen appear in several rows.

ENDOCLITA BUETTNERIA sp. nov.

Plate vii, fig. 75 and Text-fig. 35-36.

♂ Head, thorax, and legs dark brown, abdomen greyish-brown; posterior tibiae with a small ochreous tuft of hairs. Forewings relatively short, apparently rounded at apex (slightly injured in both specimens available for study), costa straight without any expansion at Sc_1 ; dark brown with paler brown indefinite markings and suffusions which are still brighter near apex, in patches along costa, and in the middle of the wing; traces of a white spot at r-m vein and two faint brown lines of suffusion from costa to hind margin, the first extending from just before apex to hinder angle, and the other from three-fourths costa to three-fifths hind margin—these, when viewed from an oblique angle, glow with scintillating greenish-blue metallic colour, while from the same angle traces of similar colour may be seen to run along the hind margin. Hindwings dull greyish-brown with traces of a dull bronze lustre. Expanse 62 mm.

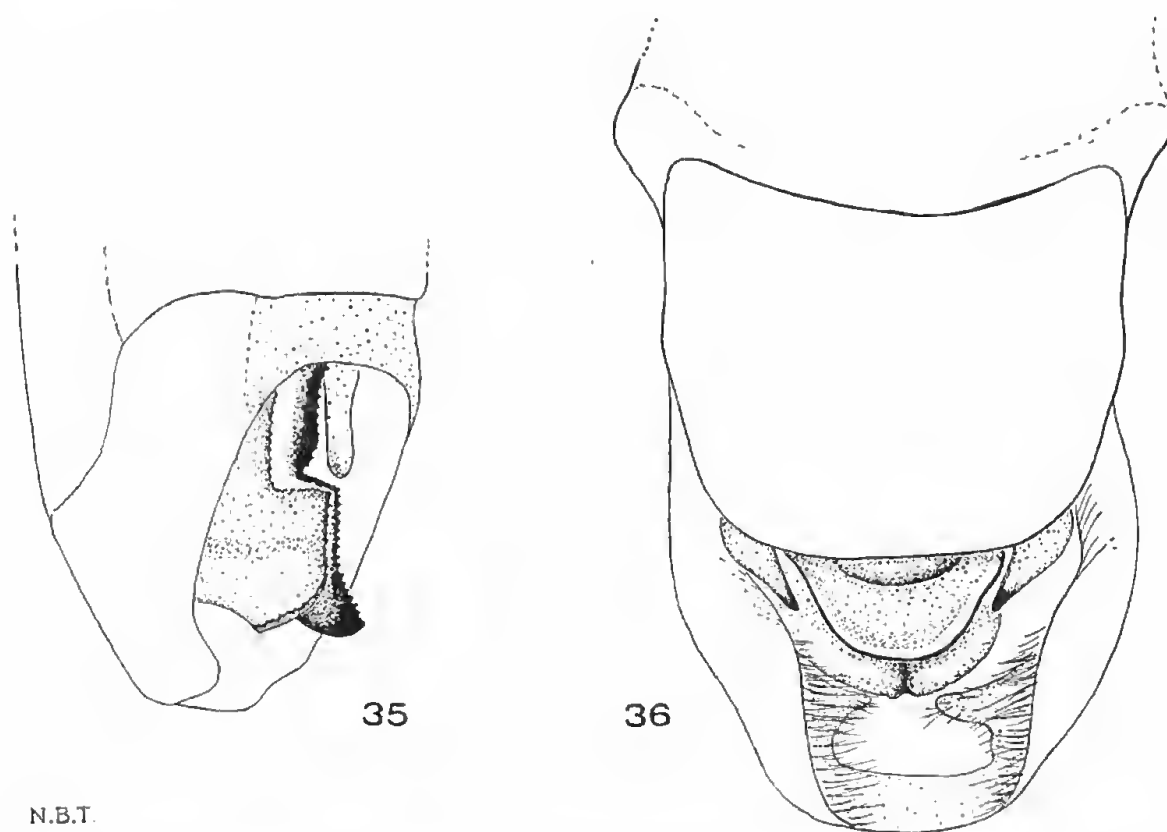
♀ Larger than male, with colour markings, so far as preserved, similar to those of males. Expanse (estimated) 90 mm.

Loc. Burma: Nanhlaing Res. Shwebo. (type, a male, 7th September, 1936, and allotype female, 25th September, 1936, collected by R. Hla Ogh, in British Museum; paratype male, expanse 68 mm., 24th September, 1936, I. 18938 in S. Aust. Museum).

The male genitalia are drawn without dissection from the type example (fig. 35); the posterior margin of the eighth sternite transverse, the tegumen with the anterior half strongly chitinized and its ventral margin serrated, the posterior

half expanded into an angulate, laterally concave lobe, also strongly chitinized, and with the margin serrated; the ventral margin of this lobe is transverse or even slightly concave in outline when viewed from the side.

The female genitalia (fig. 36) have the seventh sternite more than three-fourths as long as wide, the eighth sternite is a rounded projection, whose sides are not constricted; and there is a swollen globose anterior portion largely concealed below the seventh sternite; the anterior gonapophyses are acute spines, rather dilated near base; in other respects the genitalia are similar to those of *E. punctimargo*.



N.B.T.

Fig. 35-36. *Endoclita buettneria* Tindale. 35. Type, a male, Nanhlaing, genitalia, oblique aspect. 36. Allotype female, Nanhlaing, genitalia, ventral aspect.

The three known specimens were reared from *Buettneria pilosa* and were submitted for identification by the Forest Research Institute at Dehra Dun, who have requested that the type specimens be lodged in the British Museum.

This species is allied to *E. punctimargo*, of which only the female is well known. It differs from that species in its darker and different markings, and in the form of the genitalia. The wider anterior gonapophyses, differently proportioned seventh sternite, and the wider eighth sternite (which is not constricted as in *E. punctimargo*) are good distinguishing characters. The males resemble *E. metallica*, but are larger, have well-defined transverse markings on forewings, lack the dull metallic mirror-like surface to hindwings, and have the ventral margin of the posterior half of the tegumen straight or slightly concave rather than evenly rounded as in that species.

ENDOCLITA CHRYSOPTERA sp. nov.

Plate vi, fig. 67 and Text-fig. 37.

♂ Head, thorax, abdomen, and anterior and median legs dull yellowish-brown, posterior legs clothed with tuft of dull ochreous specialized hairs. Forewings golden-yellow with pale chocolate-brown markings; costa with a series of seven well-defined wedge-shaped brown marks; a broad band of brown (occasionally flecked with minute patches of intensely white scales) extending from base of wing obliquely to inner margin at one-half, thence irregularly towards apex, where it is dilated to form an irregularly circular brown blotch just before apex; the large brown area is flecked with somewhat larger patches of white scales, a larger group than usual being associated with the junction of r-m and M_1 ; subcostal area from base to one-half golden-yellow with obscure brown markings; subterminal area dull golden-yellow with faint brown flecks and markings; termen with a narrow band of intensely blue-white scales between the veins. Hindwings rather uniformly pale fawn; apex tinged ochreous, termen with white scales between the veins. Expanse 63 mm.

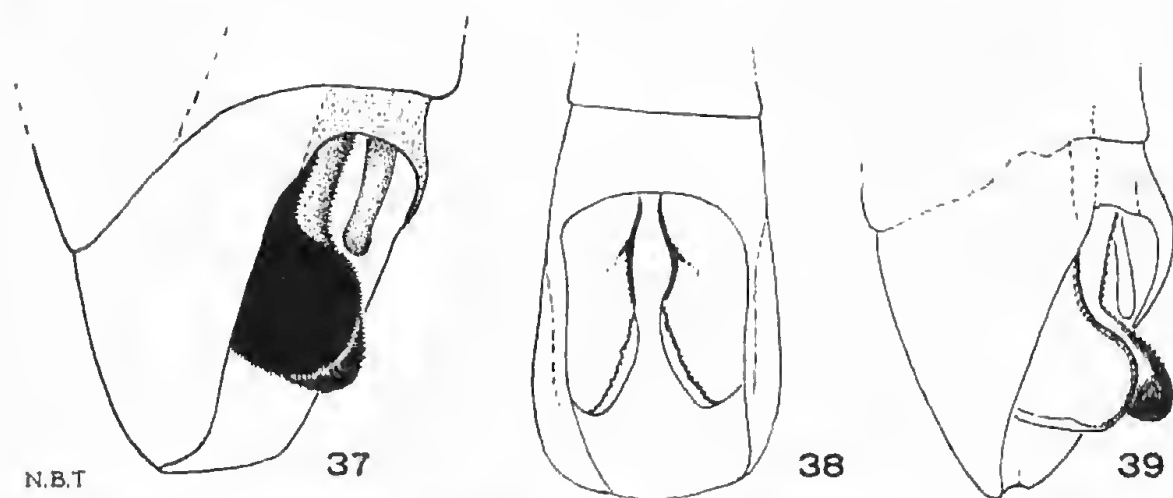


Fig. 37-39. 37. *Endoclita chrysoptera* Tindale, type, a male, unique, Senchal Range, genitalia, oblique aspect. 38-39 *E. aurata* (Hampson). 38. Male, Betnarduayo, genitalia, ventral aspect. 39. Male, a slightly oblique lateral view.

Loc. Sikkim: Senchal Range, Darjeeling 8 (type, a male, unique, reared August 3, 1923, from *Machilus edulis*, by J. C. M. Gardner; in British Museum).

Fig. 37 is an oblique view of the apex of the abdomen of the type male the genitalia of which have been drawn without dissection. The eighth sternite is rather evenly concave on the posterior margin and the tegumen is evenly and minutely serrated, the anterior half is straight and the posterior half is strongly dilated as a rounded rather flattened disc. The harpe is a simple digitiform process. This species is similar in general appearance and markings to *E. marginenotatus* (Leech, 1898) from Omei-Shan, China (at 3,500 feet in June or July), but differs in having the dark brown and golden-yellow areas differently disposed. The genitalia also are quite distinct, for the tegumen of the Chinese species is semi-circular in outline when viewed from the side and the posterior extremity of the tegumen is furnished with a long downwardly directed cylindrical process on each side. This is more than twice as long as the similar one in found *E. undulifer*. In *E. chrysoptera* there is no trace of such a spine.

ENDOCLITA AURATA (Hampson).

Plate vii, fig. 69 and Text-fig. 38-39.

Phassus auratus Hampson, 1892, Fauna Brit. Ind. Moths. i, p. 321.*Phassus auratus* Pfitzner and Gaede, 1933, p. 843, pl. lxxvi d.

♂ Head, thorax and anterior and median legs brown, abdomen paler, posterior legs with brownish-yellow tibial tufts. Forewings rounded at apex, costa straight, without swelling at Sc_1 ; brown, with obscure darker brown transverse markings; a sub-metallic golden suffusion along basal half of costa and another at apex; traces of two dull grey fasciae parallel to termen in outer half of wing; when viewed from an oblique angle the hind marginal third of wing, the two fasciae and a subcostal patch glow with an opalescent blue suffusion. Hindwings subhyaline, greyish-fawn. Expanse 44 mm.

Loc. Burma: Bernardmya, 5,500-7,000 feet (type, a male, expanse 39 mm., labelled "May, 1890, W. Doherty, Collection H. J. Elwes" in Tring Museum). Assam: Khasia Hills. 4 males.

The type expands only 39 mm., not 42 mm., as indicated in the original description. The specimen described above was taken with the type example and agrees closely with it.

The figure in Seitz is based on an example in the Senckenberg Museum doubtfully identified with this species; it is almost unrecognizable, for the markings are misplaced and the colouring is poor. The species is not a common one, and nothing is known of its life history. Its small size, rather angulate wings, and markings are distinctive.

The male genitalia (fig. 38-39) have the eighth sternite with the posterior margin transverse; the tegumen strongly chitinized; anterior half not dilated, and straight-margined, posterior half expanded into a semicircular portion; the whole of the ventral margin of tegumen is serrated with laterally set small blunt teeth.

ENDOCLITA MICROSCRIPTA sp. nov.

Text-fig. 40-41.

♀ Head, thorax, and legs brownish-fawn, abdomen slightly darker. Forewings brownish-fawn, almost completely covered with fine curved transverse lines between the veins; traces of four darker costal marks, the first at one-half followed by three smaller ones towards apex; traces of several lines of faint white spots between the veins, the first from near apex to hind margin at four-fifths, the second parallel and internal to it, from costa at five-sixths to M_1 ; a faint series also from r-m vein to hind margin at one-half, and a zigzag series between there and the base. Hindwing grey, the apex and termen narrowly tinged with fawn. Expanse 88 mm.

Loc. Madras: (type, unique, I. 18939 in S. Aust. Museum).

The female genitalia, drawn without dissection (fig. 40-41) have the seventh sternite transverse, the posterior margin sinuate, projecting in the middle; the eighth sternite is a conspicuous parallel-sided process, its posterior extremity is entire but with a depression before the apex; in lateral view it is seen to be slightly upturned at apex. The anterior gonapophysis is a broad plate with the apex drawn out into a spinous process; the penultimate tergite has ventral processes projecting towards the midline.

This is the only true *Endoclita* so far recorded from the east coast of peninsular India; one species is known from Ceylon. It is a distinct form. The genitalia are characteristic, with an eighth sternite which is nearest in form to species such as *E. damor*, but with anterior gonapophyses more like those of *E. punctimargo* and its allies.

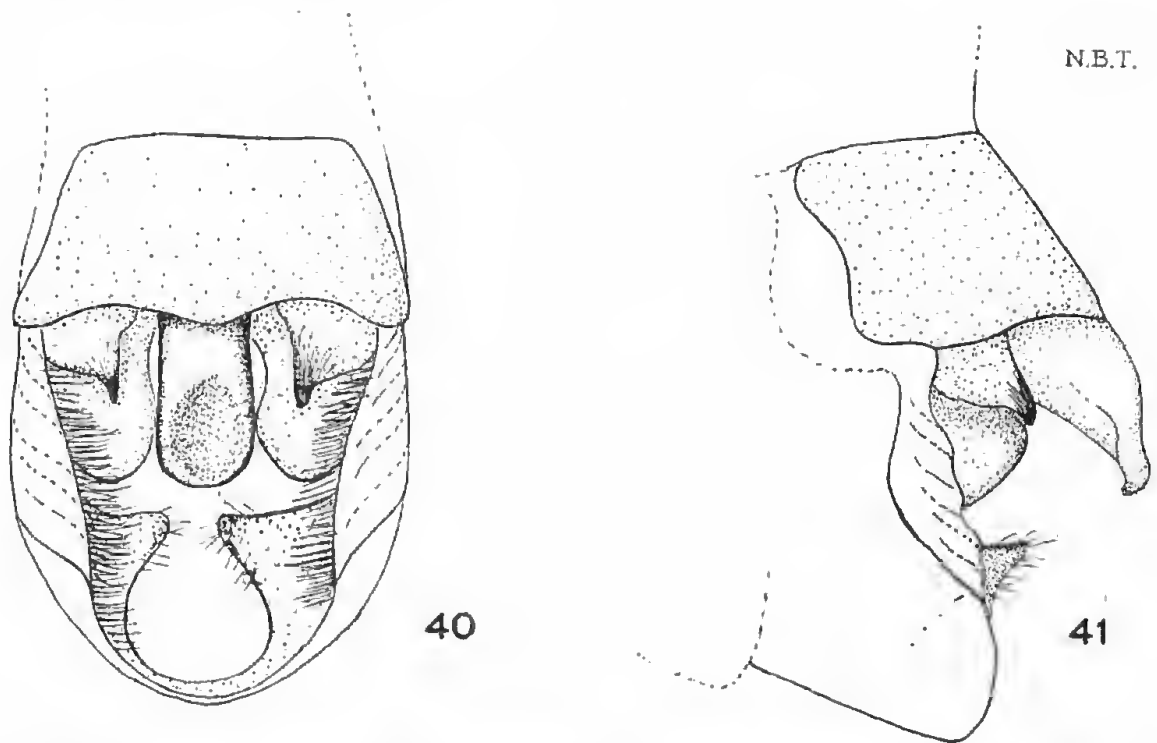


Fig. 40-41. *Endoclita microscripta* Tindale. 40. Female, Madras, genitalia, ventral aspect. 41. Female, lateral aspect.

ENDOCLITA PUNCTIMARGO (Swinhoe).

Text-fig. 42-43.

Phassus punctimargo Swinhoe (Hampson m.s.), 1892, i, p. 291 (November).
Hampson, 1892, i, p. 319 (December). Pfitzner and Gaede, 1933, x, p. 843.

♀ Head, thorax, and legs dull reddish-brown, abdomen dull greyish-fawn. Forewings reddish-brown with faint traces of yellowish-brown on costa; two parallel greyish-white post-median fasciae parallel to termen from costa, near apex, to posterior angle; each of these is bordered internally by a wide band of scales which, when viewed from an oblique angle, have a dull metallic sheen. Hindwings dull greyish-fawn. Expanse 108 mm.

Loc. Sikkim: Darjeeling, Senchal Range 8. 4 females.

Superficially examined, females of this species appear to bear considerable resemblance to *Nevina aboe* (Moore), and in the absence of authentically determined females of *N. aboe* and of males of *E. punctimargo* it might at first appear that they were merely the sexes of one species. Closer examination shows that in *E. punctimargo* Cu₂ of forewing is connected to IV by a strong oblique vein Pen. In *N. aboe* this is absent. It therefore seems certain that they are distinct.

Swinhoe anticipated Hampson's name (he has a month's priority). Both authors described the same specimens, and at least three examples were known to them. Two of these, both females, have been examined by the present writer. One

example, 92 mm. in expanse, labelled "India, No. 1349, *Phassus punctimargo* Hampson", is in the Oxford University Museum, and is the example listed as specimen "a" in Swinhoe's catalogue. The other female is in the British Museum; it is 108 mm. in expanse, and is labelled "75-25 *Phassus punctimargo* Hampson type female". Swinhoe stated that his type was in the Elwes collection. On the evidence, the type is the example, expanding 54 mm., which Swinhoe regarded as a male. Unfortunately this specimen has not been traced, hence determinations can only be based on the two female examples associated with it. The British Museum example, 108 mm., may be regarded as the allotype female. Sketches of the genitalia of the Oxford female were prepared. The example described and figured in the present paper is closely similar. It is a rather battered female from the Forest Research Institute at Dehra Dun, labelled "Senchal Range, Darjiling, 6th August, 1923", and reared by Mr. J. C. M. Gardner from *Cryptomeria japonica*.

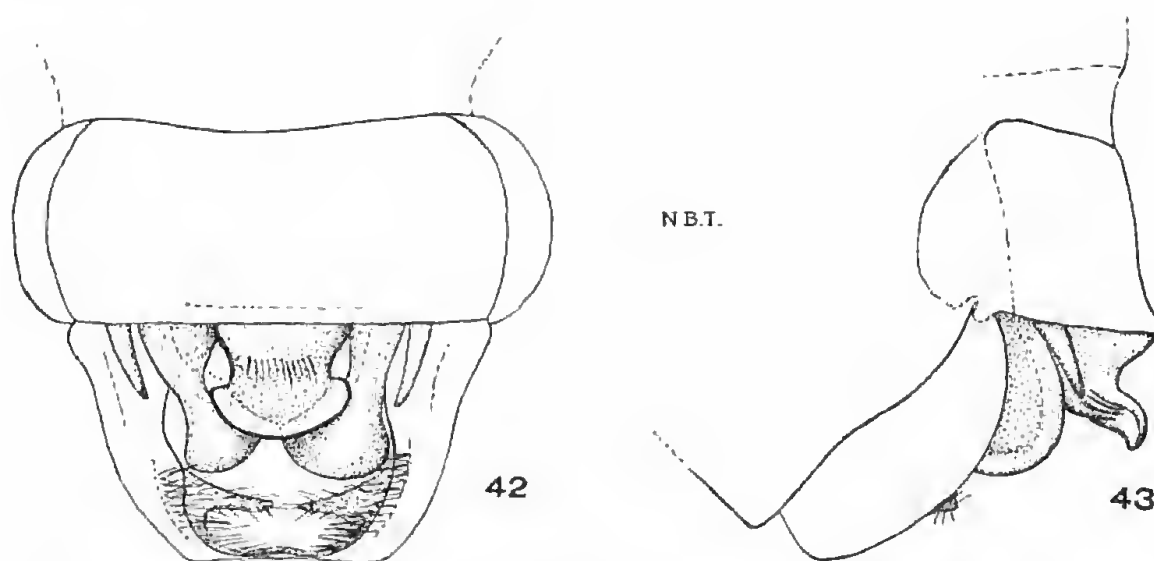


Fig. 42-43. *Endoclyta punctimargo* (Swinhoe). 42. Female, Senchal Range, genitalia, ventral aspect. 43. Female, lateral aspect.

Female genitalia (drawn without dissection from the above-mentioned Senchal Range specimen, fig. 42-43) have the seventh sternite swollen at base, and drawn out into a process which is constricted in the middle and at first down-bent, but upturned at apex; in ventral view the process is seen to be expanded into a wide spade-like appendage; the anterior gonapophyses are simple, cylindrical, tapered processes, the posterior gonapophyses are semi-circular, laterally compressed lamellae overlying and slightly posterior to the eighth sternite. The inner fold of the ultimate tergite has its lateral margin drawn out and covered with irregularly disposed hairs so that from one oblique angle it appears as a digitiform process.

Examples of this species are to be found in the British, Tring, Oxford University, and South Australian Museums.

NEVINA gen. nov.

Male with antennae simple, cylindrical, tapering gradually towards apex, composed of about 22 segments, each segment armed with a few setae; palpi two-

segmented, each about twice as long as wide. Forewings with Sc_1 present; R_1 from before middle of wing; R_2 from R_3 ; R_4 from R_5 before r-m vein; $M_1 + M_2$ and $M_3 + M_4$ separate at origin; Cu_2 not extending to margin; Pcu absent; 1V and 2V strongly Y-forked near base and extending to hind margin as a single vein. Hindwing with Sc_1 absent; R veins as in forewing; only one vannal vein present.

Genotype: *Phassus aboe* Moore.

In this genus archaic features such as the separate origins of $M_1 + M_2$ and $M_3 + M_4$ appear side by side with specializations; Cu_2 is reduced, while Pcu appears to have been entirely lost unless it is represented by the small vein forming an apparent cu-a. 1V and 2V appear as in *Endoclita* and anastomose, continuing to hind margin as a single vein. Only one species has been recognized.

NEVINA ABOE (Moore).

Plate vii, fig. 74 and Text-fig. 44-48.

Phassus aboe Moore, 1859, ii, p. 337. *Phassus salssettensis* Moore, 1879, p. 412, pl. xxxiv, f. 5. *Phassus aboe* Butler, 1886, vi, p. 30, pl. cix, f. 1; Hampson, 1892, i, p. 318.

♂ Head, thorax, abdomen, and legs dull chocolate-brown; posterior tibiae armed with orange-coloured plumes. Forewings dull chocolate-brown with darker suffusions and numerous short transverse dark brown bars between the veins, each margined, on the inner side, with pale brown; more conspicuous ones arranged in several irregular lines, the one from costa at seven-eighths to hinder angle, another from three-fourths costa to two-thirds inner margin, and traces of a third from costa at one-half; the first two of these are margined internally by a wide suffused band of pale brown; a similar suffusion covers most of the wing below Cu_{1b} ; a small white spot appears at r-m vein. Hindwings dull grey, subhyaline when worn. Expanse 46 mm.

Loc. Sikkim: Darjeeling (type, a male, 71 mm., labelled "Darjeeling East India Company 60-15 Paris Exhibition" in British Museum). Assam: Khasia Hills 6. Bombay Presidency: Bombay (allotype female, expanse 64 mm. Moore Coll. 94-106" in British Museum), Kodaikanal (7,000 ft.). Thirteen males, three females.

The type example was found, without definite type indication, in the British Museum collection, and has been marked, after checking with catalogue numbers with the original description, and with accounts given by Hampson. The allotype female, described under the name *salssettensis* by Moore, probably belongs to the same species although it was taken at Bombay, a great distance from the original locality. This species seems to have a rather wide distribution from Southern India to the Himalayas, but it is possible that the study of better series may indicate specific differences. Although superficially close to *Endoclita metallica* this species is structurally distinct and not closely related to any others.

The example figured in Seitz is a male, expanse 78 mm., from Khasia Hills; in the figure of the female given by Moore (1879, pl. xxxiv, f. 5) the markings are rather poorly indicated. For a formal description I have only males before me at Adelaide. The bodies of the males are strikingly distinct with their long spine-like rearward projection of the eighth sternite. Examples studied included one from the type locality Darjeeling; the other figured one is from Assam.

The male genitalia (fig. 47-48) drawn from the Assam example, have the eighth sternite with the posterior margin deeply excavated and the sides produced posteriorly as long spines; the tegumen has the ventral margin chitinized and

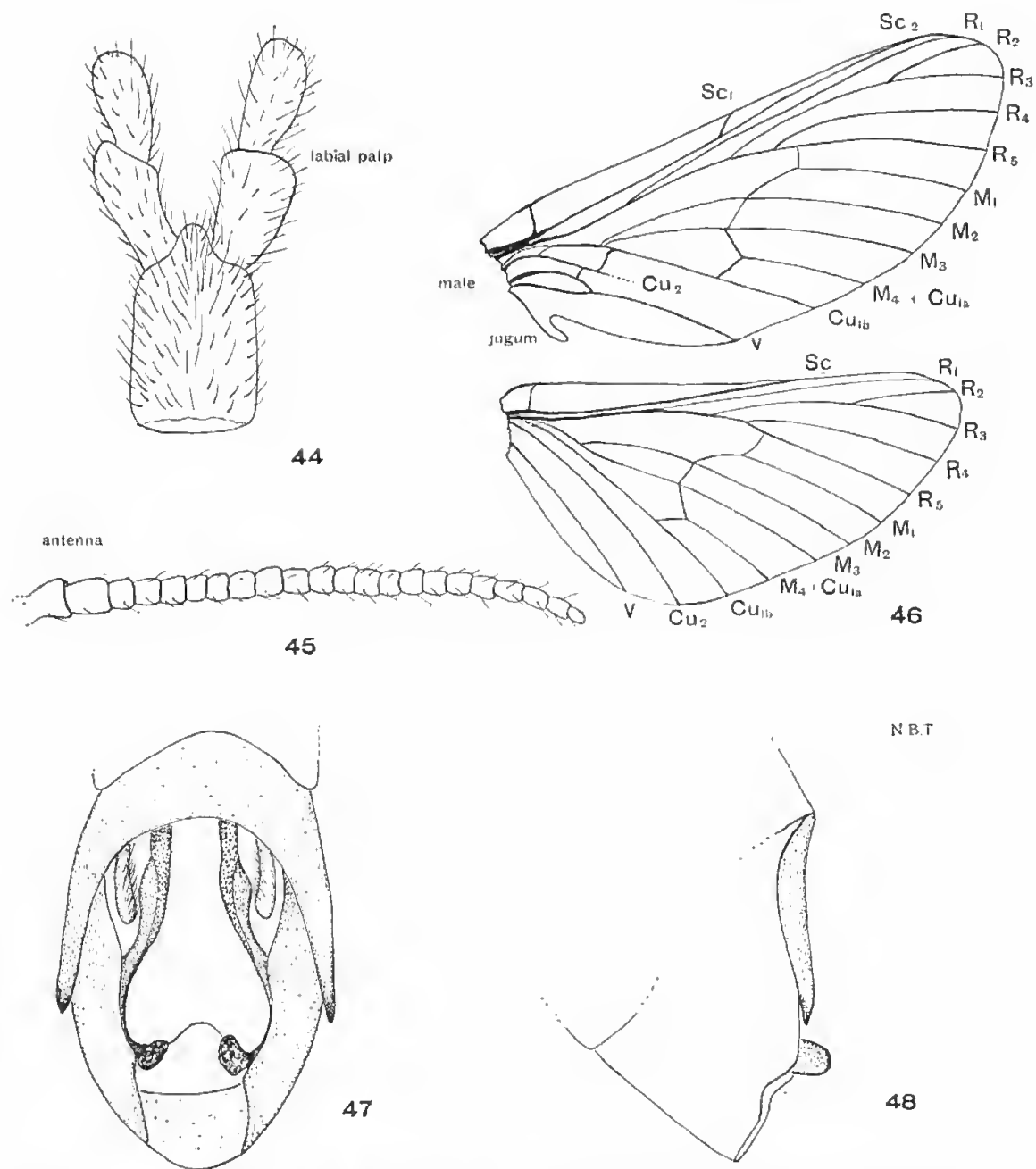


Fig. 44-48. *Nevina aboe* (Moore), Assam. 44. Labial palpi. 45. Antenna. 46. Venation of male. 47. Male, genitalia, ventral aspect. 48. Male, slightly oblique, lateral aspect.

armed with several rows of spines; the two sides diverge posteriorly, and the armature is less marked; the anal extremity of the tegumen is produced ventrally into a blunt recurved spine.

Examples of this species may be found in the British, Tring, Berlin, Senckenberg, and South Australian Museums.

STHENOPIS Packard.

Sthenopsis Packard, 1864, iii, p. 390.

Antennae short, cylindrical, tapering, composed of about 23 segments. Hypopharynx large, shield-shaped, labial palpi small, composed of two segments, first

twice as long as wide, second much smaller and globose, densely clothed in pubescence; maxillary palpi vestigial. Forewings with Sc_1 present, R_1 from before middle, R_2 and R_3 branching; R_2 to apex, R_4 from R_5 before r-m vein; Cu_2 not reaching to margin; Pcu and $2V$ not developed; $1V$ a strong vein to hind margin. Hindwings with Sc_1 absent; R_1 much reduced, R_2 and R_3 long-stalked.

Genotype: *Sthenopsis argenteomaculatus* Harris, 1841.

The only member of this essentially Nearctic genus which has been recognized as belonging to the Eastern Hemisphere is *S. regius* from Tibet. *Sthenopsis* differs from *Phassus* in the presence of Sc_1 , and in the two-segmented labial palpi. From *Endoclita* and *Nevina* it is distinguished by the absence of $2V$ in the forewings, which, in both the latter genera, forms a Y-fork with $1V$.

STHENOPSIS REGIUS (Staudinger).

Plate vii, fig. 70 and Text-fig. 49-51.

Hepialus regius Staudinger, 1895, viii, p. 301, pl. v, fig. 11. *Phassus regius* Pfitzner, 1912, ii, p. 438, pl. liv b.

♂ Head, thorax, abdomen excluding base, and legs pale fawn, base of abdomen with pink suffusions; posterior legs with tibiae ornamented with specialized plumes. Forewings brownish-grey with white transverse bands; all the markings

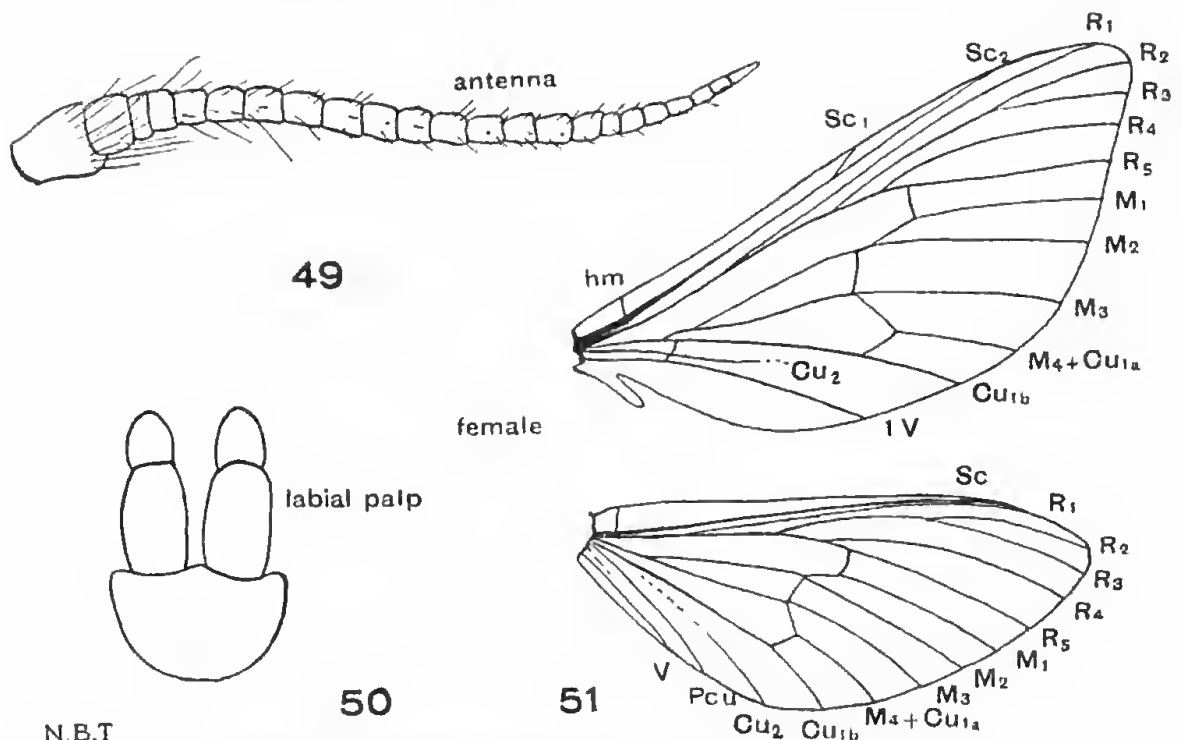


Fig. 49-51. *Sthenopsis regius* (Staudinger). 49. Female, Tibet, antenna. 50. Labial palpi. 51. Venation.

edged with metallic golden colour. Hindwings with traces of white and brown markings at apex, otherwise white with a pink suffusion, rather variable in degree. Expanse 50 mm.

♀ Similar to male, posterior tibiae without specialized plumes. Expanse 52 mm.

Loc. Tibet: between Lop Nor and Kokonor (type not seen). Kokonor 6; Amdo. Kansu Province; Sining-fu. Szechwan Province; Ta-t sien-lu. Three males, three females.

Fig. 70 depicts a male from Amdo (in the Senckenberg Museum); this has the hind wings almost white; in other examples the roseate hue is more intense. The species is an exceedingly rare one, the few specimens examined being distributed among the Berlin, Senckenberg, United States National, and South Australian Museums. I have been unfortunately unable to see the types which are, according to published measurements, larger than in those available for description.

PHASSUS Walker.

Plate vii, fig. 73.

Phassus Walker, 1856, vii, p. 1566; Druce, 1887, i, p. 233; ii, 1898, p. 451; Kirby, 1892, i, p. 889 (*P. argentiferus*); Hampson, 1892, i, p. 318 (*P. hübnéri*); Le Cerf, 1919, xxv, p. 469.

Antennae slender, simple, tapering, composed of about 28 segments. Labial palpi composed of three well-developed segments, each longer than wide. Maxillary palpi present but much reduced. Posterior legs, in male, with a tuft of specialized tibial hairs, usually orange-coloured; these are absent in female. Forewings with Sc simple, R_1 branching from R_2 well before middle of wing; R_2 and R_3 short stalked; R_4 from R_5 before r-m vein; Cu_2 not reaching to margin; Pcu obsolete; 1V a strong vein to hind margin; 2V absent. Hindwings with Sc a simple vein; R and M as in forewings; Cu_2 present; Pcu absent or represented by a short transverse vein to Cu_2 ; 1V and 2V present.

Genotype *Phassus argentiferus* Walker, 1856, nominated by Kirby, 1892.

As first noticed by Le Cerf the genus *Phassus* of older authors is a heterogeneous collection of Hepialids. The genotype was nominated by Kirby, whose selection of *P. argentiferus* has priority over that made by Hampson. The generic name belongs to a well defined group of Central American species associated with *P. argentiferus* Walker, while the Indian and other Old World species formerly placed under this name appear to belong to rather distinct genera, several of which are defined in the present paper.

Phassus ss. is nearest to *Sthenopsis*, but differs from it in the possession of three-segmented labial palpi. The reduction of Sc to a simple vein appears to be a recent specialization which has not extended to all the American species at present grouped under *Phassus*. The genotype is figured (pl. viii, fig. 73).

Additions to earlier parts of this revision are as follows:

TRICTENA BARNARDI sp. nov.

Plate vi, fig. 64.

♂ Head, with face and palpi greyish-brown, vertex slate-grey. Antennae greyish-brown, tripectinate, pectinations long and subequal. Thorax slate-grey with pale fawn undercoat; legs slate-grey and fawn. Abdomen grey. Forewings subhyaline grey, with numerous scriptose and watermark-like impressions; a greyish-white irregular longitudinal fascia from near base, and an oblique silvery-white, black- and white-bordered irregular streak from near apex to Cu_{1b} ; parallel and internal to this a series of black spots extending from apex to Cu_{1a} ; a

similar shorter series from three-fourths costa to M_3 . Hind wings opaque brownish-grey. Expanse 110 mm.

Loc. Western Australia: Lake Grace 4. (Type, a male, in Barnard Coll. at the Queensland Museum; paratype male I. 18946 in S. Aust. Museum.) Two males.

The examples were taken by the late Mr. W. B. Barnard, whose death is a great loss to those interested in the collecting of these primitive Lepidoptera. His collection is now in the Queensland Museum, Brisbane.

The two examples differ in size, that figured being 110 mm. in expanse, and the other 129 mm.

At first sight the species might be taken for a form of *Trictena argentata* (Herrich-Schaeffer, 1855, p. 5), to which it bears some resemblance in size and markings, but it is structurally distinct in the genitalia. In members of this genus the male genitalia have the tegumen large and rather weakly chitinized; except where distorted by post mortem changes it is of regular form, and may serve to distinguish the three known species, as follows:

a.	Tegumen, in lateral view, distinctly lobed	..	..	..	..	..	<i>argyrosticha</i>
aa.	Tegumen in lateral view broadly rounded, not lobed.						
b.	Tegumen subquadrately produced	..	..	..	..	..	<i>argentata</i>
bb.	Tegumen rather evenly rounded	..	..	..	..	..	<i>barnardi</i>

TRICTENA ARGENTATA (Herrich-Schaeffer, 1855).

Trictena argentata Tindale, 1932, iv, p. 500.

Several males and a female were taken, in early June, by Dr. C. T. Madigan's party, at the Hale River, on the western margin of the Arunta (or Simpson) Desert.

BORDAIA KARNKA sp. nov.

Plate vi, fig. 65.

♂ Head with face and palpi black; palpi short, not projecting, vertex black. Antennae long, pectinations long and slender, minutely ciliated. Thorax and legs long and slender, smoke-black, with a more greyish tone beneath. Forewings, opaque, greyish-black with faint scriptose markings and watermarks best evident along termen. An arcuate silvery-white fascia from base to middle of wing, broken toward middle; a faintly black margined series of conjoined white spots forming a band from near apex to Cu_{1+2} . Hindwings greyish-black, paler towards base, venation with R_2 and R_3 rather long-stalked. Expanse 79 mm.

Loc. Western Australia; Lake Grace, 4. (Type, unique, in Barnard Collection at Queensland Museum; male genitalia I. 18945 in S. Aust. Museum.)

In the key to species of *Bordaia* Tindale (1932, p. 507), this species falls into section a, in which the forewings possess conspicuous silvery-white bands. The arrangement of the wing markings is like that of *Trictena argyrosticha* Turner (1929, p. 307). In form of antennae it is nearest to *B. pica* Tindale (1932), the antennal rami being even more slender than in that species.

In the male genitalia the form of the tegumen is distinctive in lateral view, having the anterior margin excavate and followed by a low rounded eminence, behind which the margin is concave, being unlike that of any of its three congeners. The venation differs from the genotype in the length of the staking of R_2 and R_3 of hindwing, but is otherwise similar. The palpi of this species are much less conspicuously placed than in *B. maesta* Tindale, 1932, in which species they are visible from above.

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EXPLANATIONS OF PLATES.

Plate v.

- Fig. 52. *Zenophasus schamyl* (Christoph), male, Kuban, Caucasus Mountains, 83 mm.
Fig. 53. *Endoclita damor* (Moore), male, Kangra Valley, 63 mm.
Fig. 54. *Endoclita damor* (Moore), female, Mussoorie, 68 mm.
Fig. 55. *Endoclita undulifer* (Walker), allotype male, Khasia Hills, 56 mm.
Fig. 56. *Endoclita purpurescens* (Moore), male, Punduloya, Ceylon, 94 mm.
Fig. 57. *Endoclita purpurescens* (Moore), female, Maskeliya, Ceylon, 118 mm.
Fig. 58. *Endoclita chalybeata* (Moore), allotype male, Khasia Hills, 80 mm.
Fig. 59. *Endoclita chalybeata* (Moore), female, Darjeeling, 82 mm.

Plate vi.

- Fig. 60. *Endoclita signifer* (Walker), allotype male, Khasia Hills, 105 mm.
Fig. 61. *Endoclita signifer* (Walker), female, Khasia Hills, 120 mm.
Fig. 62. *Endoclita albosignata* Tindale, type, a male, Assam, 68 mm.
Fig. 63. *Endoclita rustica* Tindale, type, a male, Shillong, 56 mm.
Fig. 64. *Trictena barnardi* Tindale, type, a male, Lake Grace, 110 mm.
Fig. 65. *Bordala karnka* Tindale, type, a male, Lake Grace, 79 mm.
Fig. 66. *Endoclita rustica* Tindale, paratype male, Khasia Hills, 64 mm.
Fig. 67. *Endoclita chrysoptera* Tindale, type, a male, Senchal Range, 53 mm.

Plate vii.

- Fig. 68. *Endoclita marginenotatus* (Leech), type, a male, Omeishan.
Fig. 69. *Endoclita aurata* (Hampson), male, Bernardmyo, Burma, 44 mm.
Fig. 70. *Sthenopsis regius* (Staudinger), male, Amdo, Tibet, 50 mm.
Fig. 71. *Endoclita metallica* Tindale, type, a male, Darjeeling, 54 mm.
Fig. 72. *Endoclita gmelina* Tindale, type, a male, Namtu, 90 mm.
Fig. 73. *Phassus argentiferus* (Walker), male, Jalapa, Mexico, 112 mm.
Fig. 74. *Nevina aboe* (Moore), male, Assam, 62 mm.
Fig. 75. *Endoclita buettneria* Tindale, paratype male, Shwebo, 68 mm.